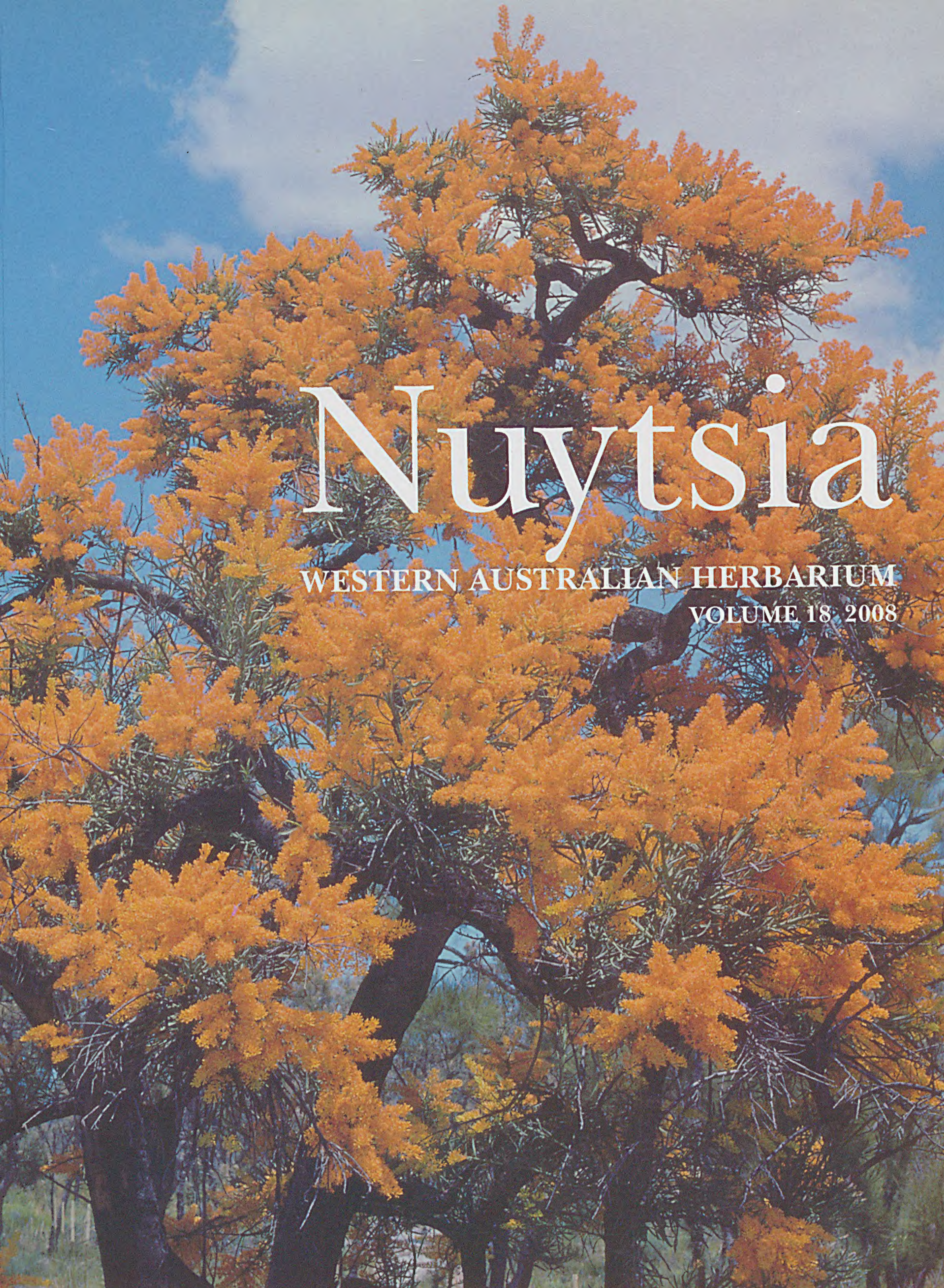

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CONTENTS

Main papers **Page**

An annotated census of the mosses of the Perth Region, Western Australia. L.J. Biggs and J.A. Chappill 1

Platytheca anasima (Elaeocarpaceae) a new, geographically restricted species from the Whicher Range, south-west Western Australia. R. Butcher 31

Rediscovery of *Tetratheca nuda* var. *spartea* (Elaeocarpaceae) in south-west Western Australia and elevation to specific rank as *Tetratheca spartea*. R. Butcher 39

Atriplex eremitis (Chenopodiaceae), a new species from northern Western Australia. R.J. Cranfield 49

Further new taxa in *Banksia* (Proteaceae: Grevilleoideae). A.S. George 53

Three new species of *Leucopogon* (Ericaceae: Styphelioideae: Styphelieae) from the far south-west of Western Australia. M. Hislop 61

A new subspecies of *Rorippa* (Brassicaceae) from southern Western Australia. G.J. Keighery 79

Elucidation of *Olearia* species related to *O. paucidentata* (Asteraceae: Astereae). N.S. Lander 83

New species of *Olearia* (Asteraceae: Astereae) from Western Australia. N.S. Lander 97

A review of *Acacia coolgardiensis* (Leguminosae: Mimosoideae) and closely related species in Western Australia. B.R. Maslin and C. Buscumb 107

Acacia diallaga (Leguminosae: Mimosoideae), a new geographically restricted species with diallagous phyllodes from the Midwest Region of south- west Western Australia. B.R. Maslin and C. Buscumb 127

Acacia umbraculiformis (Leguminosae: Mimosoideae), a new species related to *A. quadrimarginea* from the Midwest Region of south-west Western Australia. B.R. Maslin and C. Buscumb 133

New taxa of *Acacia* (Leguminosae: Mimosoideae) and notes on other species from the Pilbara and adjacent desert regions of Western Australia. B.R. Maslin and S. van Leeuwen 139

An updated diagnosis for *Eucalyptus* series *Accedentes* (Myrtaceae) and a new mallee species for the series occurring in far western Australia. D. Nicolle and M.I.H. Brooker 189

A revision of *Eucalyptus* ser. *Cornutae* subser. *Conjunctae* (Myrtaceae) from the south coast of Western Australia, including the description of four new taxa and comments on the hybrid origin of *E. bennettiae*. D. Nicolle, M. French and N. McQuoid 197

continued over

CONTENTS *(continued)*

Recognition of new taxa in *Grevillea* (Proteaceae: Grevilleoideae) from south-west Western Australia. P.M. Olde and N.R. Marriott 223

Seorsus, a new Gondwanan genus of Myrtaceae with a disjunct distribution in Borneo and Australia. B.L. Rye and M.E. Trudgen 235

Tecticornia papillata (Chenopodiaceae: Salicornioideae), a new andromonoecious samphire from near the Carnarvon Range, Western Australia. K.A. Shepherd 259

New combinations in the genus *Dysphania* (Chenopodiaceae). K.A. Shepherd and P.G. Wilson 267

Pilostyles coccoidea (Apodanthaceae), a new species from Western Australia described from morphological and molecular evidence. K.R. Thiele, S.J. Wylie, L. Maccarone, P. Hollick and J.A. McComb 273

Stylidium perplexum (Stylidiaceae): a remarkable new triggerplant from south-west Western Australia. J.A. Wege 285

A new subspecies of *Gnaphalium indutum* (Asteraceae: Gnaphalieae). P.G. Wilson 291

Coronidium, a new Australian genus in the Gnaphalieae (Asteraceae). P.G. Wilson 295

Notes on the genus *Chrysocephalum* (Angianthinae: Asteraceae) with the description of one new species from Western Australia, and a new combination. P.G. Wilson 331

Short Communications

Lepidosperma amansiferrum is an orthographic error of *L. amantiferrum*. R.L. Barrett 339

Kennedia lateritia, a new name for *Kennedia macrophylla* (Fabaceae). T.R. Lally and P.G. Wilson 340

Other contents

Referees for Volume 18 342

Corrections to Nuytsia Volume 16(2), 17 342

Conservation Codes for Western Australian Flora 343

Publication date for *Nuytsia* Volume 17 343

Notes for Authors 344

An annotated census of the mosses of the Perth Region, Western Australia

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Abstract

Biggs, L.J. & Chappill, J.A. An annotated census of the mosses of the Perth Region, Western Australia. *Nuytsia* 18: 1–30 (2008). A census of the moss species of the Perth Region is based on field studies and collections housed at the Western Australia Herbarium (PERTH). It includes 83 taxa in 45 genera and 21 families. The largest families recorded were Pottiaceae and Bryaceae. Two species not previously recorded for Western Australia, *Leptobryum pyriforme* (Hedw.) Wilson and *Pohlia nutans* (Hedw.) Lindb., are included.

Introduction

Bryophyte collections in the Perth Region began along the Swan River shortly after the British settled in Fremantle in 1829 (Stoneburner *et al.* 1993). The most significant contributors were James Drummond (1784–1863) who collected extensively from the south-west region of Western Australia, sending specimens to England, and the German botanist Ludwig Preiss (1811–1883) (Marchant *et al.* 1987).

Since the 19th century there have been a number of census catalogues including, or focusing on, Western Australian mosses (Hampe 1844; Mitten 1883; Watts & Whitelegge 1902; Bartram 1951; Willis 1954; Scott & Stone 1976), with the most recent (Stoneburner *et al.* 1993) citing 192 taxa including 30 new State records.

Western Australia is Australia's largest State, occupying over one third of the area of the continent, yet only 212 moss species have been recorded, a surprisingly low number. The Australian Capital Territory, by comparison, is only 2,400 km^2 in area but has 208 species (Streimann & Klazenga 2002). Western Australia is largely extremely dry and arid with low rainfall and humidity levels. These factors play a role in the low species diversity of Western Australian mosses. Another possible contributor is that surveys of such a large area are time consuming and therefore have not been accomplished to the same extent as those of the smaller Eastern States. The collection of the new species *Pleurophascum occidentale* R.E.Wyatt & A.H.Stoneb. in 1984 suggests that there are still more mosses to be discovered in Western Australia.

The Perth Region lies primarily on the Swan Coastal Plain, with the Swan River flowing directly through the area. Soils are of aeolian origin, consisting of shallow sandy soils over calcareous rock. This supports a number of vegetation types including coastal dunes, heathlands, woodlands, and shrublands of *Acacia*, *Banksia*, *Melaleuca* and eucalypts. Topography is low with the highest point only 60 m above sea level. Climate is described as mediterranean with hot, dry summers and cold, wet winters. Average annual rainfall for 1997–2007 was 731.88 mm with the highest rainfall recorded in 2005 with 874.8 mm and the lowest annual rainfall recorded in 2006 at 466.8 mm. Average monthly temperatures in 2006 ranged from 5.8 °C in winter to 30.4°C in summer.

Methods

In this study the boundary used for the Perth Region follows that of Marchant *et al.* (1987). The area included is approximately 10,500 km^2 and extends from the coastline west of Boyanup in the south, to Guilderton in the north, with the most easterly point at Wooroloo.

Over 700 collections from the Western Australian Herbarium (PERTH), together with additional field collections from Bold Park in Floreat and Kings Park in West Perth have been included in the survey, with each specimen being re-examined and identified for this paper. Nomenclature follows Streimann and Klazenga (2002) and McCarthy (2006). Families are listed alphabetically, as are the taxa within. Capsule descriptions have not been provided for all taxa herein as they are either uncommon for the species or have not been present during collections.

Results and Discussion

The census includes 83 species in 21 families and 45 genera (Table 1). Pottiaceae, with 19 species, and Bryaceae, with 16 species, are the most strongly represented families. These families also contained the most species in Stoneburner *et al.*'s (1993) census of Western Australian mosses. This is not surprising as they are well known habitants of arid ecosystems, often forming part of soil crusts along with lichens, cyanobacteria, algae and fungi, stabilizing the soil, reducing erosion and increasing soil nutrition (Eldridge & Tozer 1997). Fifteen species known from the Perth Region are not currently represented by collections at the Western Australian Herbarium.

There are currently reported to be 304 endemic species of moss (Streimann & Klazenga 2002) in Australia. Nine species and two infraspecific (of a total of 304 *fide* Streimann & Klazenga 2002) Australian endemic taxa are represented in the Perth Region: *Bartramia hampeana* Müll.Hal. subsp. *hampei* (Mitt.) Catches., *Campylopus australis* Catches. & J.-P.Frahm, *Campylopus flindersii* Catches. & J.-P.Frahm, *Dicranoloma diaphanoneuron* (Hampe & Müll.Hal.) Paris, *Fabronia hampeana* Sond., *Gemmabryum austrosabulosum* (Catches. ex J.R.Spence & H.P.Ramsay) J.R.Spence & H.P.Ramsay, *Gemmabryum inaequale* (Taylor) J.R.Spence & H.P.Ramsay, *Gemmabryum sullivanii* (Müll.Hal.) J.R.Spence & H.P.Ramsay, *Leptodontium paradoxum* I.G.Stone & G.A.M.Scott, *Philonotis australiensis* D.G.Griffin & W.R.Buck and *Thuidium sparsum* (Hook.f. & Wilson) A.Jaeger var. *hastatum* (Mitt.) Touw & Falter-van den Haak.

Fabronia hampeana is endemic to Western Australia and the Perth Region. Two further Western Australian endemic species, *Calymperastrum latifolium* (Hampe) I.G.Stone and *Pleurophascum occidentale* have been found in the Denmark area of the south-west, outside the Perth Region. This

Table 1. Moss families and genera of the Perth Region, Western Australia.

Familiy	Genus	Species
Archidiaceae	*Archidium*	1
Bartramiaceae	*Bartramia*	3
	Breutelia	1
	Philonotis	2
Bryaceae	*Bryum*	2
	Gemmabryum	8
	Ptychostomum	1
	Rosulabryum	5
Dicranaceae	*Campylopus*	4
	Dicranoloma	1
Ditrichaceae	*Ceratodon*	1
	Ditrichum	1
	Eccremidium	4
	Pleuridium	2
Fabroniaceae	*Fabronia*	1
Fissidentaceae	*Fissidens*	6
Funariaceae	*Entosthodon*	3
	Funaria	1
Gigaspermaceae	*Gigaspermum*	1
Grimmiaceae	*Grimmia*	2
Hedwigiaceae	*Hedwigia*	1
	Hedwigidium	1
Meesiaceae	*Leptobryum*	1
Mniaceae	*Pohlia*	1
	Schizymenium	1
Orthodontiaceae	*Orthodontium*	1
Orthotrichiaceae	*Zygodon*	1
Pottiaceae	*Barbula*	3
	Bryerythrophyllum	1
	Didymodon	2
	Gymnostomum	1
	Leptodontium	1
	Syntrichia	3
	Tetrapterum	1
	Tortella	1
	Tortula	2
	Trichostomum	1
	Triquetrella	1
	Weissia	2
Racopilaceae	*Racopilum*	1
Rhabdoweisiaceae	*Amphidium*	1
Sematophyllaceae	*Rhaphidorrhynchium*	1
	Sematophyllum	2
Splachnaceae	*Tayloria*	1
Thuidiaceae	*Thuidium*	1

number of endemic mosses is extremely low when 75% of vascular plants in the south-west are endemic (Hopper 1979). *Rhacocarpus rehmannianus* (C.Muell.) Wijk & Margad. var. *webbianus* (Müll.Hal.) J.P.Frahm was earlier thought to be a Western Australian endemic but has also been reported from South Australia (Stoneburner *et al.* 1993; Streimann & Klazenga 2002).

Calymperastrum latifolium has a conservation status of Priority Two under the Department of Environment and Conservation's (DEC) Conservation Codes for Western Australian Flora (Atkins 2008). This listing is given when taxa are known from one or a few (generally <5) populations, are not currently critically endangered, and are under consideration for declaration as 'Rare Flora' and in need of further research. *Pleurophascum occidentale* has a status of Priority Four, meaning that while adequate surveying has been undertaken it is considered rare, although not currently threatened by any identifiable factors. These taxa are monitored every 5–10 years (Atkins 2008). *Rhacocarpus rehmannianus* var. *webbianus* is considered rare under the *Western Australian Wildlife Conservation Act 1950*, meaning it has been adequately searched for and deemed to be rare and in danger of extinction or in need special protection. To date none of these species have been located in the Perth region.

Census

Archidiaceae

Archidium rehmannii Mitt., *J. Linn. Soc., Bot.* 22: 300. 15 f. 5–8 (1886).

First collected in Western Australia by Wyatt and Stoneburner from swampy areas on bare sand at Cannington Swamp. The plants are short, up to 15 mm tall, with numerous stiffly erect innovations or branches arising from below the shoot apices. The leaves are narrowly lanceolate, to 1.5 mm long, and the costa is broad. Capsules appear to be rare in Australian material. Elsewhere known only from southern Africa.

Represented by one collection from the study area.

Bartramiaceae

Bartramia breutelii Schimp. ex Müll.Hal., *Bot. Zeitung (Berlin)* 16: 162 (1858).

Bell (2006) included five species of *Bartramia* Hedw. in the moss flora of Western Australia: *B. breutelii* Müll.Hal., *B. hampeana* subsp. *hampei* (Mitt.) Catches., *B. pseudostricta* Catches., *B. robusta* Hook.f. & Wilson, and *B. strictifolia* Taylor. *Bartramia afrostricta* Müll.Hal. was included in the Western Australian flora by Catcheside (1987) but synonymised by Magill (1987) in *Anacolia* Schimp. as *A. breutelii* (Müll.Hal.) Magill. However, Bell (2006) has taken a more conservative approach to the generic placement of this taxon, retaining it in *Breutelia* pending more detailed investigation. The nomenclatural confusion surrounding *B. strictifolia* and related taxa is discussed by Catcheside (1987).

Bartramia breutelii and *B. strictifolia* both have linear-lanceolate leaves with sheathing bases. *Bartramia pseudostricta* also has linear-lanceolate leaves but these lack a sheathing base. Plants of *B. breutelii* are 1–4 cm tall, yellow-green above, brownish green below, leaves erect, closely appressed when dry, 3–4.5 mm long and 0.6–0.9 mm wide. Plants of *B. strictifolia* are generally less than 1.0 cm tall, pale yellowish green above, brown below, with leaves closely appressed when dry, 2.7–3.5 mm long and 0.6–0.75 mm wide.

The type collection of *B. strictifolia* is from 'Swan River', collected by J. Drummond, who also made an early collection of *B. breutelii* from 'Swan River'.

Represented by two collections from the study area.

Bartramia hampeana Müll.Hal. subsp. **hampei** (Mitt.) Catches., *Lindbergia* 29: 89 (2004).

Bartramia hampei (Mitt.) Catches., *Mosses of South Australia* 281 (1980).

Catcheside (1980) transferred *Bartramidula hampei* Mitt., to Bartramia. He considered that while this taxon was similar to *Bartramia papillata* Hook.f. & Wilson, the stems were generally shorter (less than 1 cm long), the leaves less widely spreading and the lamina cells narrower. He also stated that it was difficult to separate *B. hampeana* from *B. papillata* without capsules. Bell (2006) noted that while *B. hampeana* lacked a peristome, in order to differentiate it from the peristomate *B. robusta* Hook.f. & Wilson (syn. *B. papillata*), young capsules needed to be examined as the peristome was soon lost. Matteri (1984) reduced *B. papillata* to a synonym of *B. ithyphylla* Brid. Bell (2006) considered this species synonymous with *B. robusta.*

The leaves of *B. hampeana* and *B. robusta* have a sheathing base and linear-lanceolate upper lamina. Plants of *B. hampeana* subsp. *hampei*, which is endemic to Australia, are less than 1 cm tall and dull brown to yellowish green; leaves are suberect, with an oblong sheathing base and linear-lanceolate upper limb, 2–5.5 mm long, 0.4–0.5 mm wide. Plants of *B. robusta* are up to 3 cm tall and yellowish green; leaves have a sheathing base and linear-lanceolate upper limb, are 3.5–6.5 mm long, 0.5–1.0 mm wide, and the limb is wide-spreading from the sheathing base.

Represented by two collections from the study area.

Bartramia pseudostricta Catches., *Mem. New York Bot. Gard.* 45: 621 (1987).

Plants form loose tufts that are glaucous-green above and brownish below. The stems are short with the plants only up to 1 cm tall. The leaves are linear-lanceolate, erect-spreading and flexuose, and lack a sheathing base. So far the species is only known from south-west Western Australia and the Flinders and Mount Lofty Ranges in South Australia. It has been found growing in small patches on soil over rock.

Represented by three collections from the study area.

Breutelia affinis (Hook.) Mitt., *Hooker's J. Bot. Kew Gard. Misc.* 8: 261 (1856).

Only one species of *Breutelia* has been reported from Western Australia. It is easily recognised by its long (to 5 cm or more) stems that are usually branched near the apex, tomentose stems with brown hairs and leaves that are erect-spreading, ovate-lanceolate to oblong-lanceolate and have longitudinally pleated bases. Microscopically, the species is readily distinguished from other Australian species by the leaves, which have numerous quadrate alar cells that extend to about 1/3 of the leaf length.

Represented by two collections from the study area.

Philonotis australiensis D.G.Griffin & W.R.Buck, *Bryologist* 92: 376 (1989).

Bartramidula pusilla (Hook.f. & Wilson) Paris, *Index Bryol.* 116 (1894).

Minute plants, reaching only to about 5 mm high. Leaves are pale to whitish green, ovate-lanceolate to linear-lanceolate, and mostly less than 0.5 mm long. The globular to oblong, erect to pendulous capsules are borne on an erect seta up to 10 mm tall. This species is endemic to Australia.

Represented by two collections from the study area.

Philonotis tenuis (Taylor) Reichardt, *Reise Novara* 1(1): 178 (1870).

A plant of damp to wet sheltered sites, forms dense tufts with the stems to 3 cm or more tall and matted below with brown tomentum. The leaves are triangular-lanceolate to ovate-lanceolate, 0.5–1.5 mm long.

Represented by three collections from the study area.

Bryaceae

Bryaceae represents one of the larger moss families, with 15 genera and around 600 species, and is a family that has provided, and continues to provide, considerable taxonomic challenges (Spence & Ramsay 2006). Ochi (1970, 1972, 1973, 1985) based his studies of Australian Bryaceae on herbarium material only. More recently, Spence (1996, 2005), and Spence and Ramsay (1996, 1999, 2005, 2006) have included extensive field studies. Nomenclature used here follows Spence and Ramsay (2006).

Bryum argenteum Hedw., *Sp. Musc. Frond.* 181 (1801).

A common and cosmopolitan species, *B. argenteum* is frequently found in urban areas on soil, on pavements, on walls, rocks etc. Plants form patches, with the shoots densely packed and silvery green. Asexual bulbils are commonly found in the leaf axils of sterile shoots. Spence and Ramsay (2006) consider it possible that the species has been introduced to Australia.

Represented by 11 collections from the study area.

Bryum lanatum (P.Beauv.) Brid., *Muscol. Recent. Suppl.* 3: 20 (1817).

Anomobryum lanatum (P.Beauv.) J.R.Spence & H.P.Ramsay, *Telopea* 9: 785 (2002).

Like *B. argenteum*, this species is whitish green and forms dense tufts. It is often treated as a variety of *B. argenteum*. The leaf costa of *B. lanatum* is excurrent into a long hyaline hairpoint. Although Spence and Ramsay (2006) consider the hair-pointed leaves to merit specific status, intermediate forms are frequently encountered, and the retention of these as distinct species remains equivocal.

Represented by four collections from the study area.

Gemmabryum australe (Hampe) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 65 (2005).

Bryum australe Hampe, *Icon. Musc.* 26 (1844).

Forms low golden or brownish green tufts. A rare species of silty soils in open habitats, it is characterised by the stiffly erect, closely imbricate and bristle-like leaves, the costa excurrent as a long hairpoint, the leaf margins strongly recurved and the small, swollen, purple capsules (Spence & Ramsay 2006).

The type specimen was collected by L. Preiss from 'Swan River', Western Australia.

Represented by one collection from the study area.

Gemmabryum cheelii (Broth.) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 65 (2005).

Bryum cheelii Broth., *Proc. Linn. Soc. New South Wales* 4: 591 (1916).

Endemic to Australia, plants are up to 2.5 cm tall and form medium-sized, glossy red to reddish tinged tufts on rock. The leaves are 2–3.5 mm long, stiff, densely imbricate and ovate to oblong-lanceolate. The leaf margin is recurved, serrulate near the apex and lacks a differentiated border. Spence & Ramsay (2006) state that the species appears to be close to the Northern Hemisphere *Imbribryum muehlenbeckii* (Bruch & Schimp.) N.Pedersen.

Represented by one collection from the study area.

Gemmabryum chrysoneuron (Müll.Hal.) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 66 (2005).

Bryum chrysoneuron Müll.Hal., *Bot. Zeitung (Berlin)* 9: 549 (1851).

Forms loose to dense, glossy yellowish green to yellowish brown tufts that are often tinged with red. The glossy, golden green leaves with long hairpoints are distinctive. The species also produces abundant, red-coloured, rounded tubers.

The type specimen was collected by J. Drummond from 'Swan River', Western Australia.

Represented by two collections from the study area.

Gemmabryum dichotomum (Hedw.) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 66 (2005).

Bryum dichotomum Hedw., *Sp. Musc. Frond.* 183. pl. 42: f. 8–12 (1801).

A common species of wetter soils. Plants form brown to yellowish green tufts, often bearing numerous bulbils in the leaf axils. The production of numerous bulbils makes this an effective early colonist.

The type specimen was collected by J. Drummond from 'Swan River', Western Australia.

Represented by three collections from the study area.

Gemmabryum inaequale (Taylor) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 67 (2005).

Bryum inaequale Taylor, *London J. Bot.* 5: 53 (1846).

Plants are small, up to 10 mm tall, the leaves green to yellowish green and glossy. The leaves are imbricate, erect-spreading when moist, appressed when dry, and form comal tufts. Spence and Ramsay (2006) state that the species is often found on vertical earth banks. The collections have come from a variety of habitats, including crevices in rock, on soil, along drainage ditches and the edges of small streams, mostly from moister sites. The species is endemic to Australia.

The type specimen was collected in 1843 by J. Drummond from 'Swan River', Western Australia.

Represented by five collections from the study area.

Gemmabryum pachythecum (Müll.Hal.) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 64 (2005).

Bryum pachytheca Müll.Hal., *Syn. Musc. Frond.* 1: 307 (1848).

The plants form mats or tufts and are golden to reddish green. The pendant capsules are about 2 mm long, purple to crimson-brown and have the apophysis wider than the urn when moist, but narrower when dry. The apophysis is also distinctly roughened to corrugate. A common species of sandy loam soils and disturbed habitats in urban areas.

The type specimen was collected by L. Preiss in 1839 from York, Western Australia.

Represented by 16 collections from the study area.

Gemmabryum preissianum (Hampe) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 67 (2005).

Brachymenium preissianum (Hampe) A.Jaeger, *Ber. Thätigkeit. St. Gallischen Naturwiss. Ges.* 1873–74: 113 (*Gen. Sp. Musc.* 1: 575) (1875).

Plants are short and form dense green to yellowish green tufts. Spence and Ramsay (2006) give the small, lanceolate to ovate-lanceolate leaves that are up to 1 mm in length with a short stout hairpoint, and the narrow-mouthed, inclined to horizontal capsules with a rostellate operculum as characteristic of the species.

The type specimen was collected in 1823 by L. Preiss in Fremantle, Western Australia.

Represented by 6 collections from the study area.

Gemmabryum sullivanii (Müll.Hal.) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 68 (2005).

Bryum sullivanii Müll.Hal., *Oefvers. Förh. Finska Vetensk.-Soc.* 35: 48 (1893).

Stated by Spence and Ramsay (2006) to be a rare species found mainly on damp soil or rock in or near streams and often on limestone. The stems are short, only to about 3 mm tall. The plants are green to brownish green or blackish and glossy when moist, the leaves ovate, concave, weakly costate, and evenly distributed along the stems. This species is endemic to Australia.

Represented by three collections from the study area.

Ptychostomum angustifolium (Brid.) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 23 (2005).

Bryum caespiticium Hedw., *Sp. Musc. Frond.* 180 (1801), *fide* J.R.Spence, *Phytologia* 87: 23 (2005).

The plants form dense, comose tufts up to 2 cm tall, pale bright green above and brownish below. Spence and Ramsay (2006) give the elongate, thin-walled laminal cells, absence of a distinct leaf border and long excurrent hairpoint as diagnostic features. It is dioicous, having separate male and female plants. The majority of collections have come from disturbed sites, such as charcoal and burnt soil, between paving stones and along garden paths.

Represented by ten collections from the study area.

Rosulabryum albolimbatum (Hampe) J.R.Spence, *Bryologist* 99: 223 (1996).

Bryum albolimbatum (Hampe) A.Jaeger, *Ber. Thätigk. St. Gallischen Naturwiss. Ges.* 1873–74: 191 (*Gen. Sp. Musc.* 1: 653) (1875).

The genus *Rosulabryum* J.R.Spence is characterised by the plants having the leaves enlarged and crowded at the stem apex, resembling a rosette. The leaves are generally oblong-ovate with serrate margins and the plants often have rhizoidal tubers.

The plants form loose, deep green to reddish green tufts. The leaves are up to 3.5 mm long with the upper margins coarsely serrate. Filamentous gemmae are often found in the leaf axils and the rhizoidal tubers are orange, rounded to ovoid and 250–400 µm in diameter.

Ochi (1970) considered this species a synonym of *Bryum* (*Rosulabryum*) *capillare* Hedw., but later (Syed 1973) *R. albolimbatum* was recognised as a distinct species. It is a widespread Australian endemic species, occurring on soil or, more commonly, in moist and shaded habitats on wood or rock (Spence & Ramsay 2006).

The type specimen was collected by F. Mueller from the Porongorups in 1867.

Represented by eight collections from the study area.

Rosulabryum billarderi (Schwägr.) J.R.Spence, *Bryologist* 99: 223 (1996), as 'billardierei'.

Bryum billarderi Schwägr., *Sp. Musc. Frond.,* Suppl. 2: 115. pl. 76. (1816).

A widespread species growing on soil, soil over rock, or on wood. The plants form loose to dense, green to yellowish green tufts. The leaves are up to 5 mm long, with the margin distinctly toothed in the upper part, recurved towards the base and with a narrow border 1–3 cells wide. Rhizoidal tubers are red to orange, rounded to ovoid and up to 1 mm in diameter. It is a variable species and has been comprehensively revised by Haji Mohamed (1979).

Represented by 20 collections from the study area.

Rosulabryum campylothecium (Taylor) J.R.Spence, *Bryologist* 99: 223 (1996).

Bryum campylothecium Taylor, *London J. Bot.* 5: 52 (1846).

Forms yellowish green to brownish green, loose to dense tufts. The leaves have small, blunt teeth along the upper margins and the margins are recurved at the base. The marginal border is 2–4 cells wide. The costa is excurrent as a long hairpoint. Neither rhizoidal tubers nor axillary gemmae are known for the species. Spence and Ramsay (2006) state that the golden or yellow-green colour of the plants, the leaves that are ovate, concave and imbricate, and the absence of tubers are characteristic.

The type specimen was collected by J. Drummond in 1843 from 'Swan River', Western Australia.

Represented by 11 collections from the study area.

Rosulabryum capillare (Hedw.) J.R.Spence, *Bryologist* 99: 223 (1996).

Bryum capillare Hedw., *Sp. Musc. Frond.* 182 (1801).

The plants form loose to dense, dark green tufts. When dry the leaves are spirally twisted around the stems. The leaves are up to 3 mm long, the upper margins finely serrulate, and the costa is percurrent to shortly excurrent. Reddish brown, globular to ovoid rhizoidal tubers 60–250 µm in diameter are produced.

Represented by one collection from the study area.

Rosulabryum torquescens (Bruch ex De Not.) J.R.Spence, *Bryologist* 99: 223 (1996).

Bryum torquescens Bruch ex De Not., *Syllab. Musc.* 163 (1838).

A common species of drier habitats. Plants form loose to dense, green to reddish green tufts. The leaves are contorted but not spirally twisted around the stems when dry. The leaf margins are toothed, recurved, and have a strong border. Red or sometimes orange, rounded rhizoidal gemmae to 250 µm are produced.

Represented by 11 collections from the study area.

Dicranaceae

La Farge *et al.* (2000) have suggested that the genus *Campylopus* Brid. was better placed within Leucobryaceae, based on molecular genetic analysis. This transfer was adopted by Streimann and Klazenga (2002) and in McCarthy (2006). However, the transfer has not been generally accepted and is not followed by the TROPICOS database [http://mobot.mobot.org/W3T/Search/most.html]. Until further evaluation and general acceptance of the transfer, the genus *Campylopus* is here retained within Dicranaceae.

Campylopus australis Catches. & J.-P.Frahm, *J. Bryol.* 13: 360 (1985).

Catcheside and Frahm (1985) stated that this species had been found in dry sclerophyll forest having >250 mm annual rainfall. The alar cells of the leaves form a prominent auricle with the marginal cells narrower and hyaline. Above the alar cells the basal laminal cells are incrassate and coloured, rectangular adjacent to the costa and grading quickly to rectangular cells that become narrow and thin-walled near the margin. The costa occupies approximately 40% of the width of the basal part of the leaf.

Represented by nine collections from the study area.

Campylopus bicolor (Hornsch. ex Müll.Hal.) Wilson var. **bicolor**, *Fl. Nov. Zel.* 2: 69 (1854).

A species found primarily in moist habitats, e.g. in seepage channels over rock. Forms dense, dark green to dark yellowish brown tufts on wet ground or on rock. The leaves are 4–5 mm long, crowded, erect to sub-erect, concave and ovate-lanceolate, with the apex lacking a hairpoint. The costa is broad throughout the leaf, occupying 1/2–3/4 the width of the leaf base.

Represented by 17 collections from the study area.

Campylopus flindersii Catches. & J.-P.Frahm, *J. Bryol.* 13: 363, f. 3 (1985).

The plants form small green tufts with the shoots and leaves often slightly curved. The leaves are lanceolate, up to 2.5 mm long and erect-spreading when moist. The costa occupies about 2/3 of the width of the leaf base. Basal cells of the leaf are thin-walled but do not form a defined alar group. This species has not been collected fertile, although vegetative reproduction by deciduous shoot apices is common. The species is described and illustrated by Catcheside and Frahm (1985).

Represented by three collections from the study area.

Campylopus introflexus (Hedw.) Brid., *Muscol. Recent Suppl.* 4: 72 (1819 [1818]).

In its typical form, with the hyaline leafpoints reflexed outwards at right angles to the leaf, the species is readily recognisable. The leaves sometimes have the hyaline points more or less erect.

The plants form dense, golden green to light green tufts or turfs. The stems are sometimes blackish below. The leaves are 4–6 mm long, from an oblong to ovate-lanceolate, concave base, gradually tapering to a long and narrow subula ending in a roughened hyaline hairpoint. The costa is up to 3/4 the width of the leaf at the base and excurrent into the hyaline hairpoint which is reflexed. The costa has numerous parallel ridges 1 or 2 cells high on its abaxial surface, best seen in transverse section. The alar cells at the basal marginal angles of the leaves are hyaline or pale brown, but not inflated.

Represented by 111 collections from the study area.

Dicranoloma diaphanoneuron (Hampe & Müll.Hal.) Paris, *Index Bryol.* 2: 26 (1904).

The genus *Dicranoloma* Renauld (Renauld) in Australia was recently monographed by Klazenga (2003).

The species occurs on rocks, logs, tree stumps and tree stems. The plants form short, densely foliose, yellowish brown turfs. Leaves are up to 5 mm long, slender, little more than 0.5 mm wide, with an ovate-elongate base that tapers to a long, slender, channelled and irregularly falcate-secund subula. The costa is narrow and ceases in, or shortly beyond, the apex of the leaf.

The type collection of *D. diaphanoneuron* was made by F. Mueller from the Stirling Range and it is primarily a species of south-west Western Australia. Outside Western Australia, the species is known from single collections in Tasmania and Victoria. Catcheside (1980) reported it as rare in South Australia.

Represented by four collections from the study area.

Ditrichaceae

Ceratodon purpureus (Hedw.) Brid. subsp. **convolutus** (Reichardt) Burley, *Harvard Pap. Bot.* 2: 57 (1990).

Ceratodon purpureus is one of the most widespread and common mosses in the Perth Region. Because it is a common species of disturbed habitats, it is often not collected. There is considerable variation in morphology throughout its range. Often forms extensive patches as a colonist of disturbed ground. When fruiting, the purple setae and longitudinally grooved, cylindrical, inclined to nodding capsules are particularly striking.

Represented by 12 collections from the study area.

Ditrichum difficile (Duby) M.Fleisch., *Musc. Buitenzorg* 1: 300 (1904).

Plants are gregarious, forming loose to closely packed, yellowish to dark green patches. Leaves are long and flexuose, wide-spreading from a sheathing base that tapers gradually to a long and channelled subula. The capsules are asymmetric, slightly curved, and flattened when empty.

In Australia the species is distributed widely in the Eastern States, with outlying populations in South Australia and in south-west Western Australia (Seppelt 1982). A rather variable species in its gross morphology, particularly in capsule length.

Represented by four collections from the study area.

Eccremidium arcuatum (Hook.f. & Wilson) Müll.Hal., *Syn. Musc. Frond.* 1: 425 (1848).

Eccremidium Wilson is a small genus of seven species of very small mosses, six of which are found in Australia. The stems are mostly only a few millimeters tall and simple or with few branches. Spores are very large, from 60–100 µm in diameter. *Eccremidium arcuatum* and *E. pulchellum* (Hook.f. & Wilson) Müll.Hal. have julaceous stems, with the leaves short, ovoid and overlapping.

Plants of *E. arcuatum* are greenish gold above and reddish gold below. The leaves are less than 1 mm long and arranged in more or less three rows on the stems. The margins of the leaf have a characteristic serrulation, with the marginal cells extended into curled, finger-like projections (Scott & Stone 1976). When fruiting, the perichaetial leaves are considerably longer than the normal stem leaves and are usually curved to one side of the stem.

Represented by two collections from the study area.

Eccremidium exiguum (Hook.f. & Wilson) Wilson, *Rev. Bryol.* 27: 85 (1900).

The stems of this species are very short, the entire plant being only about 1 mm tall. Usually, several branches arise from the stem base, resulting in the stems appearing clustered. The leaves are mostly ovate-lanceolate, narrowing to a long subula that is filled by the costa.

Represented by one collection from the study area.

Eccremidium minutum (Mitt.) I.G.Stone & G.A.M.Scott, *J. Bryol.* 7: 603 (1973 [1974]).

The stems are very short, less than 1 mm tall and the leaves are up to 2 mm long, tapering to a relatively broad apex about 1/5 the width of the leaf. The leaf margins are often conspicuously serrate and the costa obscure.

Represented by one collection from the study area.

Eccremidium pulchellum (Hook.f. & Wilson) Müll.Hal., *Syn. Musc. Frond.* 1: 425 (1848).

Like *E. arcuatum*, this species has julaceous stems. The leaves are broadly ovate, apiculate and the margins are entire to serrate. Unlike *E. arcuatum*, the leaf margins appear serrulate by collapse or erosion of the outer cell wall (Scott & Stone 1976).

Represented by 17 collections from the study area.

Pleuridium ecklonii (Hampe ex Mitt.) Snider, *J. Hattori Bot. Lab.* 39: 155 (1975).

Archidium ecklonii Hampe ex Mitt., *J. Linn. Soc., Bot.* 22: 299 (1886), *non* Hampe ex Müll.Hal. *Hedwigia* 38: 53 (1899).

In his revision of *Archidium*, Snider (1975) excluded *A. ecklonii* from the genus and referred it to *Pleuridium* Brid. on the basis of leaf morphology and perichaetial leaves. The plants are small, up to 1 cm tall, slender, and form tufts on soil. The leaves are distant, small, up to 1 mm long, ovate-acuminate, with a percurrent costa, and held erect and close to the stems. Magill (1981) suggested that in the absence of fertile material the generic placement remained equivocal.

Represented by 17 collections from the study area.

Pleuridium nervosum (Hook.) Mitt. var. **nervosum**, *Hooker's J. Bot. Kew Gard. Misc.* 8: 257 (1856).

Stems of the plants are short, 2–5 mm tall, and tend to form dense turfs. The lower parts of the stems are julaceous. The leaves are short, 0.5–1 mm long, closely imbricate, increasing in length up the stems and becoming ovate-lanceolate. Perichaetial leaves are larger, 2–3 mm long and lanceolate-subulate. Often entirely julaceous, unbranched vegetative shoots are encountered. These are slender, barely 0.5 mm in diameter, and mostly yellowish green.

Represented by two collections from the study area.

Fabroniaceae

Fabronia hampeana Sond., *Hampe, Icon. Musc.* 13 (1844).

Fabronia incana Taylor, *London J. Bot.* 5: 58 (1846), *fide* Wijk *et al.* Index Musc. 2 (D - Hypno). Regnum Veg. 26: 535 (1962).

Fabronia tomentosa Hook.f. & Wilson, *Icon. Pl.* 6: pl. 739a (1845), *fide* Wijk *et al.* Index Musc. 2 (D - Hypno). Regnum Veg. 26: 535 (1962).

This is a highly distinctive moss, endemic to Western Australia, and easily recognized by its silvery green, imbricate, linear-lanceolate leaves that have numerous, long, single-celled cilia along the margins.

The type specimen was collected from near Perth on a trunk of *Macrozamia preissii* Lehm. The type specimens of *F. incana* and *F. tomentosa* were both collected by J. Drummond from 'Swan River'.

Represented by three collections from the study area.

Fissidentaceae

A family easily recognised by the leaves being in two rows along the stem, and the unique structure of the leaves, being Y-shaped in transverse section, with two vaginant laminae clasping the stem and a single dorsal lamina.

Fissidens bifrons Schimp. ex Müll.Hal., *Bot. Zeitung (Berlin)* 17: 198 (1859).

Plants grow on soil and are yellowish green, small, with the stems to only 3–4 mm in length, occasionally longer. The leaves are characteristically curved and asymmetric on sterile shoots and unbordered, except in the largest leaves where the vaginant laminae, which extend to more than 3/4 leaf length, are bordered. The seta is flexuose, up to 2 cm long, the capsule curved and asymmetric and barely 1 mm in length.

Catcheside (1980) listed this species as a synonym under *F. splachnifolius* Hornsch. and Magill (1981) considered *F. bifrons* a synonym of *F. pygmaeus* Hornsch. However, Stone (1994), after examining type specimens, preferred to retain all three as distinct species.

Represented by two collections from the study area.

Fissidens curvatus Hornsch. var. **curvatus**, *Linnaea* 15: 148 (1841).

Fissidens pungens Hampe & Müll.Hal., *Linnaea* 26: 502 (1855).

Plants grow on soil and are small, to about 5 mm long, scattered, yellow-green to dark green and glossy. The leaves are larger in the upper part of the stems, to about 1 mm long, slightly contorted when dry, erect-spreading when moist. The leaf apex is acute to acuminate, the margins entire and strongly bordered throughout, with the border of several cell layers. The vaginant lamina reaches to about 2/3 of the leaf length. Sporophytes are terminal, with the seta to about 1 cm long, the capsules 0.5–1 mm long, erect and symmetric to horizontal and arcuate (Magill 1981; Beever *et al.* 2002).

Represented by one collection from the study area.

Fissidens leptocladus Müll.Hal. ex Rodway, *Pap. Proc. R. Soc. Tasmania* 1912: 136 (1913).

Plants grow on rock or soil with a preference for calcareous substrates. Stems are densely aggregated, to 10 mm or slightly longer, yellow-green to dark green. Leaves are crisped when dry, often undulate and falcate when moist, linear-lanceolate to lanceolate or oblong-ovate, with an acute apex. The vaginant lamina reaches to about 2/3 of the leaf length. Leaf margins are serrulate towards the apex, entire below and with a unistratose to bistratose border that fails shortly below the apex. Sporophytes are terminal on the stems with the seta short, to about 4 mm long, and the capsules inclined, asymmetric and up to 1 mm long (Beever *et al.* 2002).

Represented by two collections from the study area.

Fissidens megalotis Schimp. ex Müll.Hal., *Bot. Zeitung (Berlin)* 16: 154 (1858).

Fissidens vittatus Hook. & Wilson, *Fl. Tasman.* 2: 167, 171, f. 6 (1859), *fide* Bruggeman-Nannenga & Pursell, *Lindbergia* 20: 51 (1995 [1996]).

Plants grow on soil or rock in exposed sites in dense, yellowish green to brownish green patches. The shoots are rolled up when dry. When moist the leaves are spreading to squarrose-recurved, falcate-secund, oblong, to about 1.5 mm long, with an obtuse and apiculate apex. The vaginant laminae extend to 2/3–3/4 of the leaf length. The leaf margins are irregularly serrulate at the apex, elsewhere entire, and with a bistratose border that is conspicuous on the vaginant laminae but inconspicuous on the dorsal and apical laminae. The upper and dorsal lamina cells are smooth to weakly multipapillose (Beever *et al.* 2002).

Represented by nine collections from the study area.

Fissidens taylorii Müll.Hal. var. **taylorii**, *Syn. Musc. Frond.* 1: 65 (1848).

Plants mostly form yellow-green to green gregarious patches or small groups on damp soil. The stems are up to 8 mm tall, with erect-spreading leaves that are little altered when wet or dry. The leaves are oblong to lanceolate, to about 0.8 mm long. The vaginant laminae reach from 2/3–4/5 of the leaf length. Leaf margins are entire to minutely serrulate, without a border except on the vaginant laminae where the border may be very weak. Sporophytes are terminal on the shoots, the seta to about 5 mm long, the capsule erect to inclined and symmetrical (Catcheside 1980; Beever *et al.* 2002).

Represented by 11 collections from the study area.

Fissidens tenellus Hook.f. & Wilson var. **tenellus**, *Fl. Nov. Zel.* 2: 62. pl. 83: f. 6 (1854).

Plants form yellowish green to dark green, loose to dense patches. The stems are short, to about 3 mm long. The leaves are spreading, little altered wet or dry, linear-lanceolate with an acute to acuminate apex and about 1 mm long. The vaginant laminae extend to about 1/2 of the leaf length. The margins are crenulate on both dorsal and apical laminae, irregularly dentate on the vaginant laminae. Lamina cells of the apical and dorsal laminae are weakly to strongly unipapillose. Sporophytes are terminal on the shoot, the seta up to 10 mm long, the capsules erect, symmetric and 0.5–0.7 mm long (Catcheside 1980; Beever *et al.* 2002).

Represented by six collections from the study area.

Funariaceae

The family Funariaceae was revised for Australia by Fife and Seppelt (2001). A family of considerable gametophytic similarity, most genera and species are distinguished primarily on features of the sporophyte.

Entosthodon apophysatus (Taylor) Mitt., *J. Proc. Linn. Soc., Bot.* 4: 80 (1859).

Funaria apophysata (Taylor) Broth., *Nat. Pflanzenfam.* 1(3): 523, 379 (1903).

Plants are yellowish green with reddish brown stems to about 5 mm tall. The capsules are erect or rarely inclined, symmetric, oblong-cylindric, 3–4.5 mm long, with a well-differentiated and tapering neck about 1/2 the capsule length, and borne on a seta 2–4 mm long. The capsule mouth is about 2/3 the width of the capsule and there is no peristome. Fife and Seppelt (2001) noted that the long, oblong-cylindric capsules without a peristome, short setae, and the comal leaves with a strong bristle-like hairpoint are distinctive features of this species.

The lectotype specimen of *Physcomitrium apophysatum* (Taylor) Wilson (syn. *Funaria apophysata* (Taylor) Broth.), was collected in 1843 by J. Drummond from 'Swan River'.

Represented by one collection from the study area.

Entosthodon productus Mitt., *Fl. Tasman.* 2: 197 (1859).

Funaria producta (Mitt.) Broth., *Nat. Pflanzenfam.* 1(3): 522 (1903).

Plants are yellowish green with reddish brown stems to about 4 mm long. The capsules are erect, symmetric and oblong-pyriform in shape, to about 1 mm long or slightly longer, gradually tapered with an irregularly wrinkled neck about 1/2 the capsule length. There is no peristome. The seta is short and less than 10 mm long (Fife & Seppelt 2001).

Represented by one collection from the study area.

Entosthodon subnudus (Taylor) Fife var. **gracilis** (Hook.f. & Wilson) Fife, *J. Hattori Bot. Lab.* 58: 192 (1985).

A species typically of fine clay or silty soils (Fife and Seppelt 2001), plants are yellowish green to brownish green, the stems reddish brown and short, to about 5 mm tall. Capsules are symmetric, obovoid to obovoid-cylindric, 1.5–2 mm long, strongly constricted below the mouth when dry, and with the mouth the same diameter as the capsule. The peristome is double. The seta reaches to about 2 cm long.

Represented by one collection from the study area.

Funaria hygrometrica Hedw., *Sp. Musc. Frond.* 172 (1801).

A common colonist species, particularly of recently burnt ground, flower pots in plant nurseries, roadsides etc. Plants form yellowish green to green patches or occur as scattered plants on disturbed ground, especially burnt sites, on burnt wood, old walls etc. Leaves are up to 4 mm long by 1 mm wide, widest above the middle. Stems may be up to 3 cm long but are usually much shorter. Most distinctive when fruiting, the setae are up to 4 cm long, arcuate and flexuose. Capsules are up to 3 mm long, 1 mm wide, pyriform, asymmetric with an oblique, red-rimmed mouth about 0.8 mm in diameter. The capsules are striate when moist, longitudinally grooved when dry and empty. There is a double peristome, with the outer ring of teeth joined to a central disc at their tip (Fife & Seppelt 2001).

Represented by 26 collections from the study area.

Gigaspermaceae

Gigaspermum repens (Hook.) Lindb., *Öfvers. Förh. Kongl. Svenska Vetensk.-Akad.* 21: 599 (1865).

Stone (2006) commented that the species was once common along undisturbed roadsides but that its abundance has been greatly reduced by weed growth and the use of fertilizers. The small, pale yellowish green shoots are often tightly clustered together and arise from a branched subterranean rhizome (Herrnstadt *et al.* 1980; Stone 2006a). This species produces abundant capsules. When fruiting the immersed capsules are globose to urn-shaped, wide-mouthed, and the brown spores are large for mosses (100–150 µm).

The type specimen was collected by L. Preiss in 1839 from 'Swan River', Western Australia.

Represented by two collections from the study area.

Grimmiaceae

Grimmia laevigata (Brid.) Brid., *Bryol. Univ.* 1: 183 (1826).

Grimmia leiocarpa Taylor, *London J. Bot.* 5: 44 (1846).

Plants form loose, dark green tufts with long, hyaline leaf apices giving the tufts a distinctly hoary appearance. Leaves are up to 2 mm long, crowded on the stems, triangular to oblong-lanceolate with a broad base, concave above and abruptly narrowed to a long, hyaline, sharply denticulate hairpoint. In transverse section the leaves are bistratose except at their base. The capsules are erect, about 1 mm long, ovoid to oblong-cylindric and smooth. Characteristic of *G. laevigata* are the erect-spreading, concave-triangular leaves and clearly denticulate hairpoints. Nearly the entire leaf lamina is bistratose and the basal marginal cells are wider than long (Greven 2003).

The type collection of *G. leiocarpa* was made by J. Drummond from 'Swan River'.

Represented by nine collections from the study area.

Grimmia pulvinata (Hedw.) Sm. var. **africana** (Hedw.) Hook.f. & Wilson, *Fl. Nov. Zel.* 2: 75 (1854).

Plants form light to dark green, usually hemispherical, hoary cushions. The lanceolate leaves are abruptly contracted into a short to long, smooth to denticulate hairpoint. The leaf margins are recurved from the apex to near the base. In transverse section the leaves are unistratose except for a bistratose margin towards the apex. The capsules are 1–1.5 mm long, with an obliquely rostellate operculum. The species is easily recognized by its neat, rounded cushions with abundant oblong-ovoid and striate capsules (Greven 2003).

Represented by two collections from the study area.

Hedwigiaceae

Hedwigia ciliata (Hedw.) P.Beauv., *Prodr. Aethéogam.* 15 (1805).

Plants form loose, yellowish green to whitish green mats with procumbent stems on rock. Leaves are ovate to ovate-lanceolate, concave, and up to 2 mm long, closely imbricate, erect and with reflexed tips when dry, spreading when moist. Leaf margins are revolute towards the base. The leaf apex is acuminate, hyaline and dentate. There is no costa. Capsules lack a peristome, are 1–1.5 mm long, subglobose with a red rim and borne on a very short seta. Mid to upper lamina cells are oblong, incrassate, thick-walled and have a single papilla over the centre of the cell on both surfaces. Basal cells are elongate and have a single row of papillae.

Represented by one collection from the study area.

Hedwigidium integrifolium (P.Beauv.) Dixon, *Skand. Bladmossfl.* 369 (1939).

Plants form loose, procumbent, green to yellowish brown mats on rock. The leaves are up to 1.75 mm long, broadly ovate-lanceolate, shortly acuminate to apiculate, spreading when moist, erect and closely imbricate when dry. The leaf margins are revolute from the base to near the apex and there is no costa. Upper lamina cells are thick-walled, oblong, incrassate, with several simple papillae. The basal lamina cells are elongate and have a single row of papillae. The capsules are broadly ovoid, to 1.5 mm long, and immersed on a short seta.

Represented by three collections from the study area.

Meesiaceae

Leptobryum pyriforme (Hedw.) Wilson, *Bryol. Brit.* 219 (1855).

A cosmopolitan annual species that is commonly found in disturbed sites. Together with *Funaria hygrometrica* and the liverwort genus *Marchantia*, it is common on flower pots in plant nurseries. The narrow, lanceolate-subulate leaves with a short, sheathing base are 2–5 mm long and arranged in comal tufts at the stem apices. The 1.5–2.5 mm long, pyriform capsule, borne on a slender 1–3 cm long seta, is characteristic.

Represented by four collections from the study area.

Mniaceae

Pohlia nutans (Hedw.) Lindb., *Musci Scand.* 18 (1879).

Vegetatively, *Pohlia* Hedw. is easily confused with *Bryum* Hedw. *sens. lat.* The lamina cells of *Pohlia* are narrow-rectangular to narrow-rhomboidal and the leaves unbordered. Lamina cells of *Bryum* are commonly rhomboid to hexagonal in shape.

Leaves of *P. nutans* are green to yellow-green, ovate to narrowly-lanceolate, 1.5–2.0 mm long, with an orange-brown costa and decurrent leaf basal angles. Leaves are smaller in the basal part of stems and clustered together in a ± comal tuft at the stem tip.

Represented by two collections from the study area.

Schizymenium bryoides Harv., *Icon. Pl.* 3: pl. 202 (1840).

Mielichhoferia bryoides (Harv.) Wijk & Margad., *Taxon* 11: 221 (1962).

The stems are short, to about 1 cm tall and reddish—which may lead to confusion with *Pohlia*—and the leaves, to 1.5 mm long, somewhat pale green and shiny. Antheridia and archegonia occur on short basal branches, whereas in *Pohlia* they are terminal on the main stems.

Represented by one collection from the study area, from damp soil.

Orthodontiaceae

Orthodontium lineare Schwägr., *Sp. Musc. Frond. Suppl.* 2(2): 188 (1827).

Plants occur on rotting wood or bark or burnt wood and are small, the stems to only about 5 mm long, with long and narrow, yellowish green leaves to about 4 mm in length. The leaves are flat and ribbon-like, tapering gradually from the base to a somewhat blunt apex. Lamina cells are long and narrow-rhomboid, becoming longer and wider towards the base. The capsules are 2–2.5 mm long, cylindrical, and usually grooved when dry and mature.

The type specimen was collected in Western Australia by J. Drummond.

Represented by one collection from the study area.

Orthotrichaceae

Zygodon menziesii (Schwägr.) Arn., *Mem. Soc. Linn. Paris* 5: 233 (1827).

Zygodon drummondii Taylor, *London J. Bot.* 5: 46 (1846).

In the study area the species has been collected on bark and from sand over limestone. The plants are up to 1 cm tall and form very dense tufts that are olive-green to dark green above and brown to reddish brown below. The leaves are up to 2 mm long, lanceolate to ovate-lanceolate, the margins recurved and the costa ceases shortly below the apex. Axillary, green to brownish, 4–8 celled asexual propagules are often found on non-fruiting plants. The leaf cells are smooth.

The type collection of *Z. drummondii* was made by J. Drummond from 'Swan River'. Lewinsky (1990) synonymised *Z. drummondii* under *Z. menziesii*.

Represented by eight collections from the study area.

Pottiaceae

The family Pottiaceae, so characteristic of dry climates, is well represented in the Perth region and in other parts of the State. Zander (1993) provided an extensive monographic revision of the family. Typically, the leaf lamina cells are papillose, but some species may lack papillae.

Barbula calycina Schwägr., *Sp. Musc. Frond. Suppl.* 1: 63, pl. 119 (1823).

Tortella calycina (Schwägr.) Dixon, *Bull. New Zealand Inst.* 3(3): 124 (1924).

Forms green to yellowish brown tufts on soil, wood, or rock. This is a rather variable species. Stems are up to 3 cm high, simple or occasionally branched. The leaves are up to 3 mm long, oblong-lanceolate, appressed and contorted when dry, erect-spreading when moist, and variably undulate. The costa is excurrent into a hairpoint of variable length. Upper lamina cells are densely papillose, isodiametric, becoming longer and elongate, hyaline and smooth in the leaf base. Axillary hairs are very long, the basal cells brownish and the upper 8–10 cells hyaline. Perichaetial leaves have a long sheathing base. The capsules are slightly inclined, asymmetric, to about 2 mm in length. The peristome is long, often longer than the capsule, arises from a basal membrane and is composed of 32 long, papillose filaments that are twisted around approximateley twice.

Represented by 75 collections from the study area.

Barbula hornschuchiana Schultz, *Syll. Pl. Nov.* 1: 35 (1824 [1822]).

Plants are small, with the stems reaching up to 1 cm tall, forming dense turfs that are olive-green to brownish green when dry and green when moist. The leaves are narrowly triangular, curled and twisted around the stems when dry, spreading to reflexed when moist. The leaf margins are strongly revolute from the base to the apex. There is a strong costa that is excurrent into a short, bristle-like point.

Represented by four collections from the study area.

Barbula indica (Hook.) Spreng., *Nomencl. Bot.* 2: 72 (1824).

Plants form loose light green tufts on soil. Stems are up to 8 mm long. The leaves are crisped when dry, spreading when wet, lanceolate to ovate-lingulate, to about 1.8 mm long, with an obtuse and apiculate apex. The margins are plane to infrequently recurved below and entire. The costa is shortly excurrent. Upper lamina cells are quadrate, with 3 or 4 large, C-shaped papillae over the lumen; basal cells are oblong, elongate, hyaline and smooth. Multicellular, brownish, obovoid gemmae are produced in the leaf axils or on axillary rhizoids (Magill 1981).

Represented by one collection from the study area.

Bryoerythrophyllum binnsii (R.Br.) Wijk & Margad., *Taxon* 8: 71 (1959).

Bryoerythrophyllum jamesonii (Taylor) H.A.Crum, *Svensk Bot. Tidskr.* 51: 200 (1957).

Plants form yellowish green to reddish brown tufts on earth or rock. The stems are up to 1 cm tall. Leaves are 1.5–2.5 mm long, oblong-lanceolate, acute, with a hyaline point. Upper lamina cells are subquadrate and papillose, becoming rectangular and hyaline at the base.

Represented by three collections from the study area.

Didymodon australasiae (Hook. & Grev.) R.H.Zander, *Phytologia* 41: 21 (1978).

Trichostomopsis australasiae (Hook. & Grev.) H.Rob., *Phytologia* 20: 187 (1970).

Forms loose tufts with the stems to about 1 cm high. The leaves are crowded, incurved or twisted when dry, spreading when moist, to about 2.5 mm long, oblong to narrowly-lanceolate, ± channelled towards the acute apex. Upper lamina cells are subquadrate to ± isodiametric with numerous papillae. Cells at the base of the leaf are elongate-rectangular, with a few marginal rows slightly narrower. Axillary hairs consist of about 4 cells with only the basal cell short and brownish. Capsules are oblong-ellipsoid and up to 2 mm long. The peristome is relatively short, less than 1/4 the length of the capsule and not twisted.

Represented by 11 collections from the study area.

Didymodon torquatus (Taylor) Catches., *Mosses S. Australia* 174 (1980).

Barbula torquata Taylor, *London J. Bot.* 5: 50 (1846).

A common species of soil in drier habitats. Stems to 1 cm tall. Leaves 1–2.5 mm long, spirally twisted around the stem when dry, spreading when moist, broadly lanceolate and acuminate, the margins closely recurved. The costa is percurrent or shortly excurrent. Upper lamina cells are subquadrate and papillose; basal cells are short rectangular, firm-walled.

The type collection of *B. torquata* was made by J. Drummond from 'Swan River'.

Represented by 12 collections from the study area.

Gymnostomum calcareum Nees & Hornsch., *Bryol. Germ.* 1: 153, pl. 10, f. 15 (1823).

Plants form dense, bright green tufts, primarily on calcareous substrates. Stems are up to 2 cm tall. Leaves are to 1 mm long, slightly twisted when dry, erect-spreading when moist, narrowly lingulate to linear, the apex mostly rounded-obtuse. Lamina cells are subquadrate to quadrate and papillose on both surfaces; basal lamina cells are rectangular and smooth. Capsules are usually numerous, to 1 mm long, elliptic-oblong to cylindrical, orange-yellow with a reddish mouth, and lack a peristome.

Represented by six collections from the study area.

Leptodontium paradoxum I.G.Stone & G.A.M.Scott, *J. Bryol.* 11: 701, f. 1–2a–d, pl. 1 (1981 [1982]).

Plants form loose, green to yellow-brown mats on soil. The stems are densely leaved, particularly in the upper parts. Leaves are slightly falcate-secund, up to 3.5 mm long and 1.0 mm wide, ovate-lanceolate to lanceolate, with a loosely sheathing base up to half the leaf length. Upper lamina cells are 6–11 µm, rounded, quadrate or sometimes short-rectangular, with 4–6 mostly simple papillae per cell. Cells of the leaf base are rectangular, with one to several marginal rows short and rectangular to quadrate. Axillary hairs are long-filamentous and consist of 9–15 hyaline cells and 2 or 3 short, sometimes pale brown, basal cells (Stone & Scott 1981).

Represented by one collection from the study area.

Syntrichia antarctica (Hampe) R.H.Zander, *Bull. Buffalo Soc. Nat. Sci.* 32: 267 (1993).

Tortula antarctica (Hampe) Wilson, *Fl. Tasm.* 2: 175, 172, f. 8 (1859).

Plants form loose, green tufts commonly on dry soils. Stems are up to 2 cm long. Leaves have a distinct red-brown costa with a toothed hairpoint. When dry the leaves become twisted but spread wide when moist. Cells are rectangular and densely papillose.

Represented by 11 collections from the study area.

Syntrichia pagorum (Milde) J.J.Amann, *Fl. Mousses Suisse* 2: 117 (1918).

Tortula pagorum (Milde) De Not., *Atti Univ. Genova* 1: 542 (1869), *fide* R.H.Zander, *Bull. Buffalo Soc. Nat. Sci.* 32: 334 (1993).

Plants form dense, green tufts or mats on trees or shrubs. The stems are up to 5 mm long. Leaves occur mostly in a terminal rosette and are incurved and appressed when dry, spreading when moist, lingulate, concave, to 2.5 mm long, 1 mm wide, with a rounded-truncate apex. The costa is reddish and excurrent into a smooth hairpoint up to 1 mm long. Upper lamina cells are quadrate, papillose, those at the base rectangular and hyaline. Small, lanceolate to elliptic, leaf-like, densely papillose propagules are produced in the axils of upper leaves.

The type specimen was collected in 1839 by L. Preiss from Rottnest Island, Western Australia.

Represented by 22 collections from the study area, all from the bark or trunks of trees.

Syntrichia papillosa (Wilson) Jur., *Laubm.-Fl. Oestrr.-Ung.* 141 (1882).

Tortula papillosa Wilson, *London J. Bot.* 4: 193 (1845).

Plants form small, dark green to greenish brown tufts on bark. The stems are up to 5 mm long. Leaves are up to 3 mm long, crowded, broadly oblong-spathulate to obovate-spathulate, concave, with a rounded, obtuse apex, the margins involute towards the apex. The costa is excurrent into a hyaline, bristle-like point of variable length. Multicellular, broadly oval or rounded gemmae are borne on the adaxial surface of the costa towards the distal part of the leaf.

Represented by four collections from the study area.

Tetrapterum cylindricum (Taylor) A.Jaeger, *Ber. Thätigk. St. Gallischen Naturwiss. Ges.* 1868–69: 86 (1869).

The stems are up to 2 cm tall. Leaves are lanceolate, to 1.5 mm long, erect to erecto-patent, with a broader, hyaline base. When dry the leaves are folded along the costa, incurved and spirally twisted around the stems. The costa is strong and shortly excurrent. Upper lamina cells are irregularly hexagonal and papillose; basal lamina cells are short-rectangular with firm walls. The capsule is oblong to cylindrical, 1–1.4 mm long, emergent from the perichaetial leaves, and the seta is short, about 1–2 mm long.

Represented by two collections from the study area.

Tortella rubripes (Mitt.) Broth., *Nat. Pflanzenfam.* 1(3): 397 (1902).

Trichostomum rubripes Mitt., *Handbook of the New Zealand Flora* 417 (1867).

An apparently coastal-maritime species. Plants form dense tufts on earth or rock and are pale green to yellowish green above, brownish below, to 1.5 cm tall. Leaves are to 3 mm long, crowded, crisped when dry, erect-spreading when moist, lingulate or linear from a widened oblong base. Leaf margins are entire, incurved towards the apex, with an obtuse and cucullate apex. The costa is excurrent into a short mucro. Upper lamina cells are ± isodiametric and densely papillose; those at the leaf base are hyaline, thin-walled, rectangular, and extend obliquely up the margins.

Represented by three collections from the study area.

Tortula muralis Hedw., *Sp. Musc. Frond.* 123 (1801).

A moss that exhibits a strong preference for old, calcareous surfaces, plants form loose cushions on rock or stone and are particularly common on old cement and mortar. Stems are short, to about 5 mm long. Leaves are up to 3 mm long, oblong to oblong-lingulate, the apex obtuse or rounded, the margins revolute from the apex to well down the lamina. The costa is excurrent into a smooth, hyaline hairpoint. Upper lamina cells are subquadrate and densely papillose; those of the leaf base are rectangular, with a few marginal rows shorter and narrower.

Represented by 24 collections from the study area.

Tortula recurvata Hook., *Musc. Exot.* 2: 130 (1819).

Desmatodon recurvatus (Hook.) Mitt., *Fragm.* 11 suppl: 114 (1881).

Similar to *Tortula atrovirens* (Sm.) Lindb. but larger and darker green. Stems to 3 mm long. Leaves 1.5–3 mm long, to 0.7 mm wide, oblong to oblong-lanceolate, acute to acuminate; margins revolute towards the apex. Costa obscured by its papillose cells adaxially towards the distal part of the leaf, excurrent in a short mucro. Upper lamina cells are subquadrate, densely papillose, about 4–6 marginal rows not papillose; those of the leaf base are rectangular, with a few marginal rows shorter and narrower. Seta longer than in *T. atrovirens*, 1–2 cm tall; capsule also longer, to 2.4 mm long, dark brown. Occurs on soil and banks in moister habitats than *T. atrovirens* (Catcheside 1980), which has not yet been recorded for the Perth Region.

Represented by one collection from the study area.

Trichostomum eckelianum R.H.Zander, *Bull. Buffalo Soc. Nat. Sci.* 32: 92 (1993).

Tortella cirrhata Broth., *Nat. Pflanzenfam.* 1(3): 397 (1902), *fide* Zander, *Bull. Buffalo Soc. Nat. Sci.* 32: 92 (1993).

Trichostomum cirrhatum Hampe, *Icon. Musc.* 28 (1844), *nom. illeg.*

A common moss of sandy soils, plants form dense, yellow-green to green tufts on calcareous rock or soil. Stems are up to 2 cm tall. Leaves 2.5–3.5 mm long, crowded, crisped and glossy when dry, spreading when moist, linear-lanceolate to lingulate from a widened, hyaline, oblong base; apex narrowly acuminate; margins undulate, incurved in the upper half. The costa is strong and excurrent into a sharp point. Upper lamina cells are quadrate and densely papillose; basal cells are rectangular, hyaline, thin-walled, sharply differentiated from the papillose cells above and extend obliquely up the margins.

Represented by 14 collections from the study area.

Triquetrella papillata (Hook.f. & Wilson) Broth., *Nat. Pflanzenfam.* 1(3): 399 (1902).

Plants form loose, wiry patches of irregularly branched, yellowish brown shoots. The ovate-lanceolate leaves are 1–1.5 mm long, tightly appressed to the stems when dry, wide-spreading to squarrose when moist and then in three distinct rows with a slight spiral twist along the shoots. Leaf margins are variably recurved in the lower parts of the leaves. The lamina cells are small, rounded, densely papillose on both surfaces with 1 or 2 high, and often branched, papillae per cell.

Represented by two collections from the study area.

Weissia controversa Hedw., *Sp. Musc. Frond.* 67 (1801).

Plants are small, bright green or yellowish green and occur in dense turfs or cushions. The stems are erect, to 5 mm tall. Upper leaves are linear-lanceolate, concave, to 3 mm long, strongly crisped when dry, erect-spreading when moist. Leaf margins are plane below but strongly involute above. The costa is excurrent into a short mucro.

Represented by six collections from the study area.

Weissia rutilans (Hedw.) Lindb., *Öfvers. Förh. Kongl. Svenska Vetensk.-Akad.* 20: 417 (1863).

Plants are similar in appearance to *Weissia controversa* but grow in wetter habitats (Catcheside 1980). The leaves are oblong-lanceolate to linear-lanceolate and the margins are plane throughout. The costa is excurrent into a short mucro.

Represented by two collection from the study area.

Racopilaceae

Racopilum cuspidigerum (Schwägr.) Ångstr. var. **convolutaceum** (Müll.Hal.) Zanten & Dijkstra, *Fragm. Florist. Geobot.* 40: 411 (1995).

Racopilum convolutaceum (Müll.Hal.) Reichardt, *Reise Novara* 1(3): 194 (1870).

Plants are dark green to yellowish green and form dense mats with the stems densely tomentose with brown rhizoids. The stems are irregularly sub-pinnately branched. The leaves are in four rows, with the two lateral rows larger, up to 2 mm long, oblong-lanceolate to oblong-ovate and more or less asymmetric. Leaf margins are plane and serrulate. The dorsal rows of leaves are smaller, ovate to ovate-cordate and have entire margins.

A type specimen was collected by F. Mueller in 1867 from the Porongorups, Western Australia.

Represented by 21 collections from the study area.

Rhabdoweisiaceae

Amphidium cyathicarpum (Mont.) Broth., *Nat. Pflanzenfam.* 1(3): 460 (1902).

Amphidium tortuosum (Hornsch.) Cufod., *Oesterr. Bot. Zeitschr.* 98: 221 (1951).

Plants form dense pads on rock, up to 3 cm tall, with shoots bright green above and rusty brown below. The leaves are up to 3 mm long, very narrow, keeled and strongly curled when dry. The lamina cells are small, quadrate, thick-walled, with numerous rounded low papillae on both surfaces. Basal lamina cells are rectangular and thin-walled.

Represented by two collections from the study area.

Sematophyllaceae

Sematophyllaceae is a large, species-rich and heterogeneous pleurocarpous moss family (Buck 1998) with around 53 genera (Buck 1982) and 600 species, best developed in tropical and subtropical regions (Tan *et al.* 1996; Ramsay *et al.* 2002). The family is characterised by having plants with leaves lacking a costa, linear or rhombic lamina cells, a well-differentiated alar region with the cells often seriate, inflated and vesiculose, stems often red and lacking a central strand, usually foliose pseudoparaphyllia, usually collenchymatous exothecial cells, and a double peristome. The family is, however, in need of much revisionary work (Buck 1998).

Rhaphidorrhynchium amoenum (Hedw.) M.Fleisch. var. **amoenum**, *Musc. Buitenzorg* 4: 1249 (1923).

Sematophyllum amoenum (Hedw.) Mitt., *J. Linn. Soc., Bot.* 12: 487 (1869).

Plants form dense, glossy, yellow-green to yellow-brown mats, usually on wood. The stems are up to 5 cm long, closely pinnately branched with lateral branches up to 1 cm long, and with dense tufts of rhizoids on the lower side. Leaves are ovate-lanceolate, acuminate, up to 1.5 mm long and less than 0.5 mm wide, and falcate to circinate or secund. Upper lamina cells are linear (L:W = 10–12:1), incrassate and porose. Cells at the leaf base are shorter and wider, yellowish, with a few alar cells inflated and hyaline, and with a small number of smaller and irregularly quadrate supra-alar cells.

Represented by two collections from the study area.

Sematophyllum homomallum (Hampe) Broth., *Nat. Pflanzenfam.* 2, 11: 433. (1925).

This is a rather xerophytic species often found on exposed rock, sometimes corticolous, and rarely in wetter habitats (Ramsay *et al.* 2002). Plants form dense, glossy, golden yellow to bronze-green or reddish mats. The stems are up to 3 cm long and irregularly pinnate. The leaves are ovate-lanceolate to oblong, short, bluntly acuminate, concave, markedly secund, erect, not falcate, 1.25–1.75 mm long, 0.5 mm wide, slightly concave and with entire margins. Laminal cells are somewhat thickened, incrassate, frequently porose and narrow-elongate (L:W = 8–10:1). The alar region has 3 or 4 rows of orange or yellow, quadrate, incrassate cells, with the basal row of 3 or 4 cells enlarged but not inflated, and quadrate supra-alar cells (Ramsay *et al.* 2002). The often shiny bronze colour is characteristic.

Represented by 32 collections from the study area.

Sematophyllum subhumile (Müll.Hal.) M.Fleisch. var. **contiguum** (Mitt.) B.C.Tan, W.B.Schofield & H.P.Ramsay, *Nova Hedwigia* 67: 219 (1998).

Sematophyllum contiguum (Mitt.) Mitt., *Fl. Vit.* 398 (1873).

Very close to *S. subhumile* var. *subhumile* and differing in the number of differentiated and inflated alar cells (Sainsbury 1955). The leaves have more acute apices than var. *subhumile* and the margins of the perichaetial leaves are serrulate. Ramsay *et al.* (2002) consider these taxa to be very close and there appears to be considerable variation in morphological characteristics.

Represented by six collections from the study area.

Splachnaceae

Plants of the family Splachnaceae have mature capsules which emit chemical attractants to insects, which then disperse the spores to fresh dung.

Tayloria octoblepharum (Hook.) Mitt. var. **octoblepharum**, *Trans. & Proc. Roy. Soc. Victoria* 19: 65 (1882).

A moss found usually on old dung, but also sometimes on rotten wood or other organic substrates. It occasionally occurs on soil or rock. Plants usually form dense tufts. The leaves are pale green, 2–4 mm long and taper to a point. The capsules are borne on a stout, erect seta, and are up to 3 mm long, about 0.4 mm wide, with the spore-containing urn about 1/4–1/2 the capsule length.

Represented by two collections from the study area.

Thuidiaceae

In their revision of Thuidiaceae in Australasia, Touw and Falter-van den Haak (1989) included *Thuidiopsis* (Broth.) Fleisch., within their concept of *Thuidium* Bruch & Schimp. Later, Touw (2001) recognised them both as distinct genera. That treatment is not accepted here. Distinguishing features of Thuidiaceae include the pinnate to tri-pinnate fronds, the abundant filamentous and papillose stem paraphyllia, the shortly mamillose or papillose lamina cells, and the leaves with a strong single costa.

The first specimen of a *Thuidium* from Australasia was collected by L. Preiss from 'Swan River province' (Touw & Falter-van den Haak 1989) and is now referred to *T. sparsum* (Hook.f. & Wilson) A.Jaeger var. *hastatum* (Mitt.) Touw & Falter-van den Haak.

Thuidium sparsum (Hook.f. & Wilson) A.Jaeger. var. **hastatum** (Mitt.) Touw & Falter-van den Haak, *J. Hattori Bot. Lab.* 67: 24 (1989).

Plants are pale green to yellowish green, the branching mostly bipinnate. Stem leaves are 1.0–1.5 mm long, 0.8–1.0 mm wide, ovate-cordate to ovate-triangular to broadly triangular. Leaves of the ultimate branchlets are small, to 0.3 mm long, broadly ovate to ovate-oblong, the median leaf cells pluri-papillose

Represented by nine collections from the study area.

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Platytheca anasima (Elaeocarpaceae) a new, geographically restricted species from the Whicher Range, south-west Western Australia

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Abstract

Butcher, R. *Platytheca anasima* (Elaeocarpaceae) a new, geographically restricted species from the Whicher Range, south-west Western Australia. *Nuytsia* 18: 31–37 (2008). *Platytheca anasima* R.Butcher is described as a new species restricted to the Whicher Range of south-west Western Australia and distinguished from other *Platytheca* taxa. A distribution map and images of the new species are provided.

Introduction

Platytheca Steetz is a south-west Western Australian endemic genus with two currently described species: *P. galioides* Steetz and *P. juniperina* Domin. The genus was previously included, along with *Tetratheca* Sm. and *Tremandra* R.Br. ex DC., in Tremandraceae, but molecular cladistic analyses (Bradford & Barnes 2001; Crayn *et al.* 2006) now recognise this southern Australian endemic family as a well supported clade nested within Elaeocarpaceae.

Of the two currently recognised species, *P. juniperina* is restricted to quartzitic or granitic slopes in the southern part of the State and is morphologically consistent across its range. By contrast, *P. galioides* is widespread in a range of habitats across the south-west and displays considerable variation in number of leaves per whorl, leaf length and width, and in the indumentum of stems, leaves, pedicels and calyx segments. These parts may be glabrous or densely hispidulous throughout, or have various combinations of simple and glandular hairs. Some forms of *P. galioides* have been formally recognised at various taxonomic ranks in the past, but these names have all been synonymised under *P. galioides* (Joy Thompson *in sched.*; Chapman 1991).

Flora surveys of the Whicher Range, conducted between 1995 and 2006 by the Wildflower Society of Western Australia and the Department of Environment and Conservation (DEC), have led to two additional phrase-named taxa being recognised, namely *Platytheca* sp. Argyle (G.J. & B.J. Keighery 281) and *P.* sp. Sabina (G.J. & B.J. Keighery 295) (Western Australian Herbarium 1998–). Each of these taxa has more characters in common with *P. galioides* than with *P. juniperina*. While *P.* sp. Argyle (G.J. & B.J. Keighery 281) can be easily distinguished by a consistent suite of morphological characters, *P.* sp. Sabina (G.J. & B.J. Keighery 295) is closely allied to some collections of the morphologically variable *P. galioides* and is still under taxonomic review.

Platytheca sp. Argyle (G.J. & B.J. Keighery 281) is described herein as the new species *P. anasima* R.Butcher, prior to the taxonomic resolution of *P.* sp. Sabina (G.J. & B.J. Keighery 295), as it is potentially threatened by mineral sands mining activities and its formal description will help assist its conservation management.

Methods

All specimens of *Platytheca* at MEL and PERTH were examined, including types of *P. crassifolia* Steetz (=*P. galioides*), *P. crucianella* Steetz (=*P. galioides*) and *P. galioides*. Herbarium acronyms follow Holmgren and Holmgren (1998–) except CFR. which refers to the Central Forests Region regional herbarium in Bunbury, Western Australia. Stem width and foliage measurements were taken from both herbarium specimens and material preserved in 70% ethanol. Where values differed under different treatments, this has been noted. Floral measurements were taken from rehydrated flowers and material preserved in 70% ethanol.

The term strigillose is used here to describe the indumentum on the ovary and fruit of *P. anasima* and is used as a diminutive form of strigose, defined by Radford *et al.* (1974: 140) as 'covered with sharp, coarse, bent trichomes usually with a bulbous base'. Hewson (1988: 19) recommends against the inclusion of swollen hair bases in the definition (accepted here) and defines strigose as 'covered with appressed, rigid, bristle-like, straight trichomes'. The minute hairs on the ovary of *P. anasima* are more similar to those in the first definition, however, being bent above a bulbous base, then appressed to the ovary surface.

The distribution map was prepared using DIVA-GIS freeware Version 5.0.2.0. (http://www.diva-gis.org), from PERTH specimen data, and shows *Interim Biogeographical Regionalisation for Australia (IBRA) Version 6.1* boundaries (Department of the Environment, Water, Heritage and the Arts 2008).

Taxonomy

Platytheca anasima R.Butcher, *sp. nov.*

Ab speciebus aliis omnibus turma sequenti characteorum distinguitar: caulibus verticillibus 5-8-foliatis; foliis latis (0.7–4.3 mm), obovatis, conduplicatis, apiculatis; pedicellis pilis glanduligeris fasciculatis; ovario strigoso abbreviato.

Typus: south-east of Capel, Western Australia [precise locality withheld for conservation reasons], 7 November 2007, *R. Butcher & J.A. Wege* RB 1247 (*holo*: PERTH 07719787; *iso*: CANB, HO, K, MEL, NSW).

Platytheca sp. Argyle (G.J. & B.J. Keighery 281), Western Australian Herbarium, in *FloraBase*. http://florabase.dec.wa.gov.au [accessed March 2008].

Sprawling to *erect shrub*, 0.5–1.5 m high, 0.6–1.0 m wide. *Stems* alternately branched, rarely opposite, slender, terete, straight, apices indeterminate, yellowish green infused with pink to pinkish brown when young, orange-brown when mature, with a transparent to very pale grey, thin, flaky bark, not glaucous, smooth or rugulose when dry, longitudinally ridged below expanded nodes, internodes glabrous or hispid (often on the same branch). *Leaves* 5–8-whorled, persistent, ±horizontal becoming strongly declinate; petiole articulate, compressed with thickened midvein on abaxial surface, 0.2–0.55 mm long, yellow-green aging to tan-brown, glabrous but surrounded by a ring of long, simple hairs encircling the node; blade narrowly to broadly obovate, flat to abaxially conduplicate, 1.3–10.4 mm long, 0.7–4.3 mm wide at maturity; apex rounded to truncate, with a stiff, acutely triangular, up-turned apiculus (0.25–0.5 mm long); base attenuate; margins entire, ±flat to shortly revolute, with openly spaced, short, tubercle-based simple hairs; adaxial surface mid-green, glabrous or with scattered short, tubercle-based simple hairs or tubercular remnants, not glaucous, smooth to slightly wrinkled; abaxial surface very pale, dull, light green, glabrous; main veins usually distinct on both surfaces. *Flowers* single in leaf axils; 1 or 2(3) per flower-bearing whorl. *Bracts* absent. *Pedicels* bulbous at base, straight then curved in upper third or just below receptacle, 17.5–29.5 mm long, 0.15–0.25 mm wide, pale yellow-green infused with pink to pink-red, darker towards apex, glabrous except for a cluster of long (0.5–1.1 mm long) red-tipped, glandular hairs in the lower half, not glaucous, tapering and gently fluted to ridged in the upper part into a receptacle 1.2–1.6 mm wide. *Calyx* segments 5, inserted at edge or just inside receptacle rim, deciduous after anthesis, lanceolate, 7.1–10.1 mm long, 1.9–2.5 mm wide, reflexing strongly during anthesis; apex acuminate; margins ±flat, slightly thickened; outer surface pale green to pale pink when fresh, drying purple, glabrous; inner surface with yellow area at base, bearing a few simple hairs at apex and short, thick, glistening villi just inside margins. *Petals* 5, deciduous, broadly obovate with narrowed base to ±obcuneate, 11–13 mm long, 8–13 mm wide with the widest point in the upper third; apex broadly rounded to sub-truncate with an acute triangular projection (0.6–0.9 mm long) from centre, blue or purple with a magenta flare at base above a distinct yellow spot. *Stamens* 10, in 2 dimorphic, alternating whorls, all free; *outer stamens* opposite petals, shorter than inner stamens, 5.3–7.1 mm long; filaments flattened, 0.25–0.5 mm long, yellowish pink, glabrous; anther body compressed, gently arcuate, 2.0–2.7 mm long, dark red, dorsal surface papillose, margins and upper half of ventral surface bearing simple hairs and large tubercles (with or without an apical hair); tube narrow, geniculate near base, 3.1–4.1 mm long, yellow, bearing simple hairs and large tubercles (with or without an apical hair) in lower two-thirds; *inner stamens* 6.3–7.9 mm long; filaments thickened, wedge-shaped, 0.05–0.3 mm long, yellowish pink; anther body compressed but with a thicker ridge along mid-line, very gently arcuate, 2.3–3.3 mm long, red; margins and upper third of ventral surface bearing simple hairs and large tubercles (with or without an apical hair); tube very narrow, ±straight, 3.5–4.5 mm long, yellow, with simple hairs and large tubercles (with or without an apical hair) in lower half. *Ovary* elliptic in outline, thickened and fleshy along outer margins of locules with a thickened ridge along the septum (appearing ±4-lobed in TS), 1.4–1.7 mm long, 1.2–1.6 mm wide, cream-pink to tan, densely strigillose, glabrous internally; *style* kinked at base then straight, 4.9–5.2 mm long, yellow-pink, strigillose or strigose for up to half its length; expanding abruptly into a simple *stigma* at apex; *ovules* 2, 1 in each locule, attached near the apex of the septum by a small but distinct placenta. *Fruit* a loculicidal and tardily septicidal capsule, ovate to ±circular in outline, compressed dorsiventrally, 4.4–6.5 mm long, 4.0–5.2 mm wide, light brown, strigillose. *Seed* ovoid, planoconvex, 3.4–4.0 mm long, 2.4–2.5 mm wide, obtuse to rounded proximally, flattened to convex distally, light brown; testa with a thin membranous coat and large, inflated simple hairs, these with rounded apices lacking a filiform extension.(Figure 1)

Specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons]1 Nov. 2005, *E.M. Bennett & D. Brearley* HV 10-7 (PERTH 07331568); 1 Nov. 2005, *E.M. Bennett & D. Brearley s.n.* (PERTH 07331576); 7 Nov. 2007, *R. Butcher & J.A. Wege* RB 1248 (AD, BRI, PERTH 07719795); 22 Oct. 1997, *R. Davis* 4407 (PERTH 04926552); 17 Nov. 2005, *S.A. Fisher* BNC 733 (CFR., PERTH 07318170); 21 Oct. 2004, *G.J. & B.J. Keighery* 281 (PERTH 06985556); 282 (PERTH 06972926); 283 (PERTH 06985548); 284 (PERTH 06985513); 11 Dec. 2005, *G.J. & B.J. Keighery* 714 (PERTH 07325754).

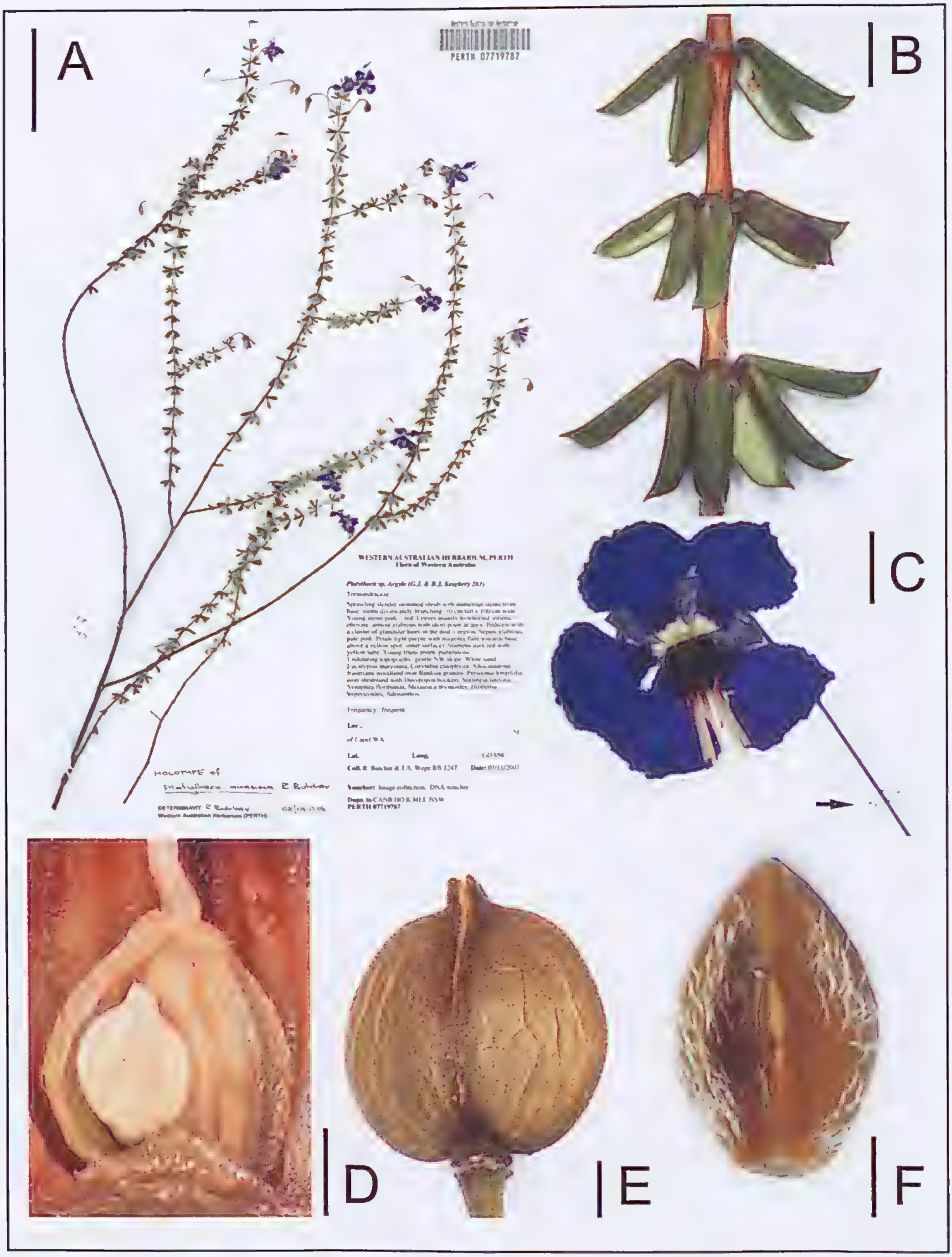

Figure 1. *Platytheca anasima*. A – holotype (*R. Butcher & J.A. Wege* RB 1247); B – abaxially conduplicate, discolorous, 6-whorled leaves showing stiff apiculus; C – pressed flower showing yellow spot at the base of the petals, stamen morphology and cluster of glandular hairs on the pedicel (arrowed); D – rehydrated, dissected ovary with strigillose indumentum, showing fleshy septum and single ovule per locule; E – fruit showing strigillose indumentum; F – dorsal surface of seed showing inflated hairs which lack a filiform terminal extension. Scale bar = 5 cm (A); 5 mm (C); 1 mm (B, E, F); 0.5 mm (D). Images B–F from *G.J. & B.J. Keighery* 281 (PERTH).

Phenology. Buds, flowers and fruits seen together on specimens collected from mid-October to mid-December.

Distribution and habitat. Platytheca anasima has been collected from State Forest *c.* 15 km east-south-east of Capel (Figure 2). It grows on gentle slopes of white-grey sand or brown sandy loam in mixed *Eucalyptus marginata*, *Corymbia haematoxylon*, *C. calophylla* and *Allocasuarina fraseriana* low woodland over *Banksia grandis*, *Kingia australis*, *Persoonia longifolia* and *Xylomelum occidentale*. Associated shrub species include *Acacia lateriticola*, *Dasypogon hookeri*, *Banksia dallanneyi*, *Hibbertia hypericoides*, *Isopogon sphaerocephalus*, *Kunzea recurva*, *Melaleuca thymoides*, *Pericalymma ellipticum*, *Stirlingia latifolia*, *Synaphea floribunda* and *Xanthorrhoea preissii*.

Conservation status. Listed as Priority Two under DEC Conservation Codes for Western Australian Flora, as *P.* sp. Argyle (G.J. & B.J. Keighery 281) (Atkins 2008). *Platytheca anasima* is currently known from only three areas within 10 km^2 across two Forest Blocks. Potential threats include sand mining activities and *Phytophthora cinnamoni* disease risk.

Etymology. From the Greek *anasimos* (with turned-up nose), in reference to the broad leaf apex with its up-turned apiculus.

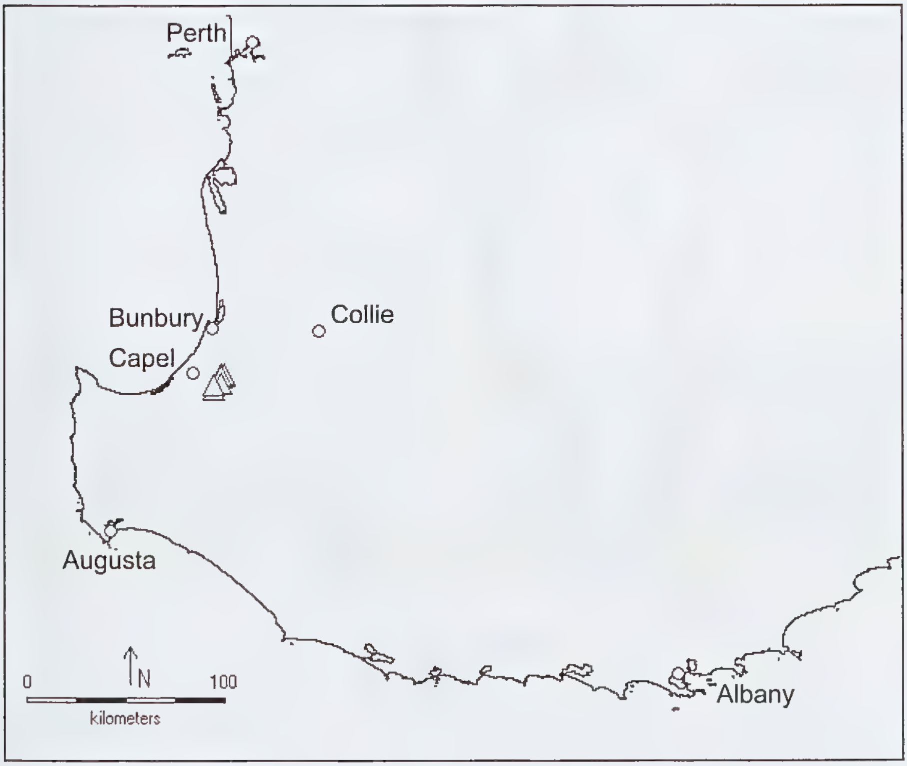

Figure 2. Distribution of *Platytheca anasima* (△) in south-west Western Australia.

Affinities. *Platytheca anasima* can be distinguished from all other *Platytheca* species by the following combination of characters: 5–8-whorled, obovate, ±flat to abaxially conduplicate leaves, which have a small but distinct, stiff, up-turned apiculus, a cluster of long, glandular hairs in the lower half of the otherwise glabrous pedicel, and strigillose indumentum on the ovary (and therefore the fruit).

Platytheca juniperina is similarly distinctive in its stiff, ±linear, glabrous, pungent leaves, which have strongly revolute margins (±triangular in TS), broad, distinctly fluted receptacles, and ±glabrous ovary (and therefore the fruit; both may have a few simple and/or short glandular hairs at the apex).

By comparison, leaf shape in *P. galioides* varies from linear with very strongly revolute margins (±terete to ±triangular in TS), to elliptic or obovate, especially on lower parts of the plant. The latter leaf shapes are characteristic of *P.* sp. Sabina (G.J. & B.J. Keighery 295). While the apex of the leaf may be incurved in *P. galioides*, both these taxa lack the stiff, up-turned apiculus characteristic of *P. anasima*. *Platytheca galioides* and *P.* sp. Sabina (G.J. & B.J. Keighery 295) may also possess glandular hairs on the pedicel, but these are usually intermixed with simple, hispid hairs when present, and are not found in the distinct cluster seen in *P. anasima*. Similarly, these taxa have a longer, denser ovary indumentum than *P. anasima*, and may also have short glandular hairs mixed with the simple hairs.

Notes. The seeds of *P. juniperina* and *P. galioides* have both inflated and slender hairs (Boesewinkel 1999, Figures 31–34 and Downing *et al.* 2008, Figure 3j, k, respectively) with most inflated hairs terminating in a slender, hair-like projection. *Platytheca anasima* seeds apparently have inflated hairs only, and these lack a filiform, terminal extension (Figure 1F). Further observation of seeds of all taxa is needed, however, to assess whether this character is diagnostic or whether it varies with seed maturity.

Platytheca galioides has been collected with (e.g. *G.J. & B.J. Keighery* 715; PERTH) and in close proximity to (e.g. *R. Butcher & J.A. Wege* RB 1249; PERTH) *P. anasima*.

Acknowledgements

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Rediscovery of *Tetratheca nuda* var. *spartea* (Elaeocarpaceae) in south-west Western Australia and elevation to specific rank as *Tetratheca spartea*

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Abstract

Butcher, R. Rediscovery of *Tetratheca nuda* var. *spartea* (Elaeocarpaceae) in south-west Western Australia and elevation to specific rank as *Tetratheca spartea*. *Nuytsia* 18: 39–47 (2008). *Tetratheca nuda* Lindl. var. *spartea* Planch. ex Benth. was named by Bentham in 1863 from material collected from an unspecified locality by Drummond in 1843. Mueller placed the name in synonymy under *T. virgata* Steetz in 1882, but Thompson recognised and lectotypified the name in 1976, reiterating the close affinity with *T. nuda* but querying the status of the taxon. The taxon was known only from the type material until a 2005 collection from near Toodyay was confirmed as comparable with the type. Additional collections have since confirmed its distinctness from *T. nuda*. This taxon is described in full herein as *T. spartea* (Benth.) R.Butcher. Images of the new species and a distribution map are provided, as is an amended taxonomic key to the species of 'leafless' *Tetratheca* in Western Australia.

Introduction

Tetratheca nuda Lindl. var. *spartea* Planch. ex Benth. was named by George Bentham in 1863, following its recognition by Jules Émile Planchon in William Jackson Hooker's herbarium at the Royal Botanic Gardens, Kew. Based on *Drummond,* Coll. 1843, n. 101 and 104, Bentham's description of *T. nuda* var. *spartea* was 'Tubular process of the anthers nearly as long as the cells.' (1863: 133). Ferdinand von Mueller (1882: 5) later included *T. nuda* var. *spartea* in the superficially similar *T. virgata* Steetz, presumably due to the length of the anther tube, but a number of characters (discussed below) serve to easily distinguish the two taxa. In her revision of *Tetratheca* Sm., Joy Thompson (1976: 165) referred to *T. nuda* var. *spartea* under *T. nuda*, and designated *Drummond* 101 herb. Hook., 1843 (K) as the lectotype, with MEL 1008122 cited as an isolectotype. Thompson did not resolve the status of this taxon, but regarded the long anther tube and a dark patch at the base of each petal as significant differences from typical *T. nuda*.

Examination of all typical *T. nuda* specimens at PERTH, MEL and NSW confirms that the anther tube is consistently short (0.35–0.5 mm long) in this species, but that the dark patch at the base of the petals is commonplace. Although Thompson (1976: 139) reported that hybridisation is extremely rare in *Tetratheca* (it has not been observed among the Western Australian species, T.D. Macfarlane pers. comm.), she suggested that *T. nuda* var. *spartea* might represent an hybrid between *T. nuda* and, possibly, *T. hirsuta* Lindl., a species characterised by its extremely long anther tubes and large, black spot at the base of each petal. Thompson's annotation on the isolectotype of *T. nuda* var. *spartea* (Figure 1) in 1974 states '*T.* sp. aff. *nuda* or *T. nuda* × ? (*hirsuta*?)', highlighting that she thought the taxon may be a distinct species, but reflecting a reluctance to recognise it at a different rank in the absence of further collections.

A 2005 collection of *Tetratheca* from an area of the Julimar State Forest north-west of Toodyay (*F. Hort* 2895), is comparable to the isolectotype of *T. nuda* var. *spartea*. Corresponding closely with *T. nuda* in habit and floral form, this collection differs from typical *T. nuda* and is identical to *Drummond* 101 in stamen morphology, in having only large-headed glandular hairs on the ovary, and in its slightly thicker stems with minute glandular hairs. Thompson's hypothesised hybrid status for *T. nuda* var. *spartea* can now be discounted, as the closest known population of typical *T. nuda* is *c.* 30 km to the south-west, in the Avon Valley National Park. *Tetratheca hirsuta* does not co-occur with *T. nuda* var. *spartea*, although it has been collected from other areas of the Julimar State Forest (e.g. *M. Hislop* 2330; *F. & J. Hort* 2893; *C.L. Wilson* 834). The only other *Tetratheca* species occurring with *T. nuda* var. *spartea* is the distinctly different *T. pilifera* Lindl. (e.g. *R. Butcher, F. Hort & J. Hort* RB 1178; *F. & J. Hort* 2898, 2899). Nearly 500 flowering individuals of *T. nuda* var. *spartea* have been recorded at its rediscovery site. Plants are morphologically consistent across the population, as well as consistently different from *T. nuda*. Consequently, *T. nuda* var. *spartea* is recognised here at an elevated taxonomic rank as the new species *T. spartea* (Benth.) R.Butcher.

Drummond 101 is without locality information. However, the recent collections of *T. spartea* from the Julimar State Forest are *c.* 20 km away from James Drummond's property 'Hawthornden', near Toodyay. The Toodyay–Bolgart area was extensively sampled during Drummond's second, third and supplemental collections between 1843–1844 (Erickson 1969; Barker 2005; Maslin & George 2005) and Erickson (1969: 87) recounts that '[a]fter a year of almost constant field work and exploration during 1842 James Drummond spent most of 1843 at 'Hawthornden''. It appears highly likely, therefore, that *T. spartea* was originally collected in close proximity to Drummond's home, and the 162 year gap in its collection history suggests that it is a rare species, geographically restricted to this immediate area.

Methods

All *Tetratheca* specimens at PERTH were examined as well as material of Western Australian species, including types, on loan from MEL and NSW. Herbarium acronyms follow Holmgren and Holmgren (1998–). Stem width and foliage measurements were taken from both herbarium specimens and material preserved in 70% ethanol. Where values differed under different treatments, this has been noted. Floral measurements were taken from rehydrated flowers and material preserved in 70% ethanol. The distribution map was prepared using DIVA-GIS freeware Version 5.0.2.0. (http://www.diva-gis.org), from PERTH specimen data, and shows *IBRA (Interim Biogeographical Regionalisation for Australia) Version 6.1* boundaries.

A taxonomic key to the 'leafless' species of *Tetratheca* in Western Australia was published by Butcher (2007: 140–141). However, due to the length of its anther tube, *T. spartea* cannot be neatly inserted under lead 7. of that key and included in the same group as *T. angulata* R.Butcher, *T. applanata* R.Butcher and *T. nuda*, taxa with which it shares the greatest morphological similarity. An amended key is therefore presented here.

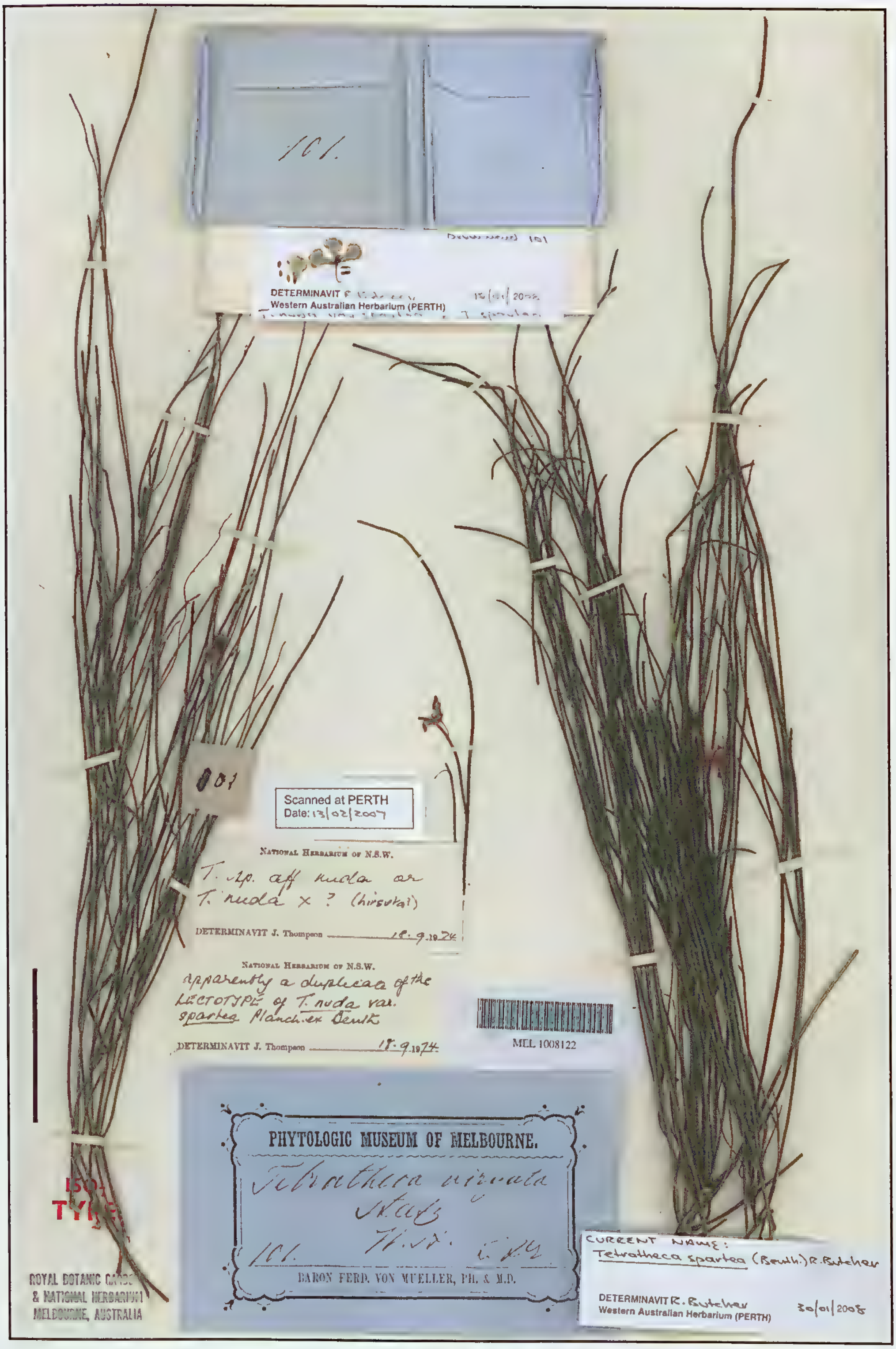
101.
Western Australian Herbarium (PERTH)
Scanned at PERTH
Date: 13/02/2007
National Herbarium of N.S.W.
T. sp. aff nuda or
T. nuda x ? (hirsuta?)
DETERMINAVIT J. Thompson 18.9.1974
National Herbarium of N.S.W.
apparently a duplicate of the
LECTOTYPE of T. nuda var.
spartea Planch. ex Benth
DETERMINAVIT J. Thompson 18.9.1974
MEL 1008122
PHYTOLOGIC MUSEUM OF MELBOURNE.
Tetratheca
101.
BARON FERD. VON MUELLER, PH. & M.D.
CURRENT NAME:
Tetratheca spartea (Benth.) R. Butcher
DETERMINAVIT R. Butcher
Western Australian Herbarium (PERTH)
30/01/2008
TYPE
ROYAL BOTANIC GARDENS
& NATIONAL HERBARIUM
MELBOURNE, AUSTRALIA

Figure 1. Isolectotype of *Tetratheca nuda* var. *spartea* (MEL 1008122). Additional flowers and fragments are contained within Mueller's packets. Scale = 5 cm.

Taxonomy

Tetratheca spartea (Benth.) R.Butcher, *stat. nov.*

Tetratheca nuda Lindl. var. *spartea* Planch. ex. Benth., *Fl. Austral.* 1: 133 (1863). *Type*: *Drummond*, Coll. 1843, n. 101 (*lecto*: K *n.v.*; *isolecto*: MEL 1008122!; *fide* Thompson 1976). Excluded syntype: *Drummond,* Coll. 1843, n. 104. NSW 125190! = *T. paucifolia* Joy Thomps.

Clumped *sub-shrub*, 0.45–0.6 m high, 0.15–0.3 m wide. *Stems* numerous from base, alternate, slender, mostly leafless, terete, straight but often curved in upper part, apices determinate, senescing into short silver-black points, 0.7–1.2 mm wide in flowering region, younger stems light green, striate, older stems mid-green, drying dull light olive-green, rugulose to irregularly striate, papillose with sparse, minute, red-tipped glandular hairs (to 0.1 mm long), these concentrated near stem bases and towards apices of younger stems and usually caducous. *Leaves* alternate, caducous, sparse, ascending with apex incurved; petiole applanate and concave in TS, persistent and appressed to stem after blade falls, 0.6–1.2 mm long, cream-pink, glabrous or with occasional small, red-tipped glandular hairs, not glaucous; blade ±linear to elliptic, 0.8–2.5 mm long, 0.4–0.9 mm wide; apex acute to obtuse, usually with a short, red-tipped glandular hair; margins flat, entire, with sparse, short, red-tipped glandular hairs; adaxial surface light green, glabrous or with a few simple hairs towards apex, not glaucous; abaxial surface light green, glabrous or pubescent towards apex or with sparse small, red-tipped glandular hairs, not glaucous. *Flowers* solitary in leaf axils. *Bracts* paired, linear, narrowly triangular or narrowly ovate, 0.5–0.9 mm long, 0.2–0.4 mm wide, green and pink or red, adaxial surface with either simple hairs or a mixture of simple and small, red-tipped glandular hairs along margin and towards apex, abaxial surface glabrous or with scattered small, red-tipped glandular hairs or a mixture of glandular and simple hairs in the upper half. *Pedicels* gently curved at base then ±straight or gently curved along length, 5.7–7.5 mm long, 0.15–0.3 mm wide, red becoming green towards apex, mostly glabrous with sparse papillae and occasional glandular hairs in upper third, not glaucous, very finely striate, expanding abruptly at apex into a receptacle 1.5–1.8 mm wide; receptacle with some warty projections and scattered, usually reflexed, red-tipped glandular hairs 0.2–1 mm long. *Calyx* segments 5(6), inserted inside receptacle rim, the base thickened and folded with the thickened portion on top of the rim, deciduous, ovate or elliptic, 2.3–2.9 mm long, 1.5–1.7 mm wide, concave in TS, apex acute to obtuse, erect; margins thinner, flat to gently reflexed; outer surface pink, glabrous but with warty thickenings mainly in the lower half, or also with scattered red-tipped glandular hairs; inner surface with few, fine, short hairs inside margin and towards apex, mid-vein thickened. *Petals* 5(6), deciduous, broadly obovate with a distinctly narrowed base, 9.9–12.2 mm long, 7.1–10 mm wide with the widest point at 7.3–7.7 mm length (*c.* 1/3 from the apex), apex broadly rounded, with a small triangular fold from the centre, bright pink with purple-black patch at base (to 3 mm length). *Stamens* 10(12), 3.3–3.9 mm long, free or very shortly fused into pairs at base; filaments fleshy, compressed, obliquely angled, 0.3–0.6 mm long, red-purple, a little paler than the anther body, pubescent on all surfaces; body gently curved from the filament on the inner edge, ±straight for a distance then slightly incurved into the tube, outer edge broadly curved from filament then strongly incurved at juncture with the tube, 1.6–2.1 mm long, dark red-purple, pubescent at base on outer surface, on entire inner surface and in depressions between anther cells on lateral surfaces; tube arising smoothly from the body on inner edge, distinctly contracted from the body on the outer edge, gently curved along its length, 1.3–1.6 mm long, orifice narrow, oblique, lower lip slightly longer than upper lip, dark red-purple, paler at tip, pubescent on inner edge in lower third. *Ovary* ±circular in outline, compressed, with a thickened rim at base, 0.8–1.1 mm long, 0.7–1.1 mm wide, pink to red, with a moderately dense to dense external covering of long glandular hairs, these with large, red, ±globular (L:W = 1:1–1:1.25) heads when fresh, becoming ±discoid when dried, glabrous internally; *style* straight to slightly kinked in the mid-region, 2.3–3.1 mm long, red at base grading into yellow at apex, glabrous; *stigma* simple, sometimes shortly tufted; *ovules* 2, 1 in each locule, attached near the apex of the septum by a small placenta. *Fruit* not seen. *Seed* not seen. (Figure 1)

Specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 27 Sep. 2007, *R. Butcher, F. Hort & J. Hort* RB 1179 (K, MEL, NSW, PERTH 07719590), RB 1180 (CANB, PERTH 07719582); 1843, *J. Drummond* 101 (MEL 1008122); 9 Nov. 2005, *F. Hort* 2693 (AD, PERTH 07217331); 7 Oct. 2006, *F. Hort & J. Hort* 2895 (HO, PERTH 07719604).

Distribution and habitat. Known only from a single area within the Julimar State Forest, north-west of Toodyay (Figure 2), growing in red-brown clayey loam with lateritic gravel over laterite. Most commonly seen in and around shallow gullies below lateritic breakaways. Occurs in *Eucalyptus accedens* open woodland with *Gastrolobium spinosum*, *Acacia pulchella*, *Macrozamia reidlei*, *Hakea lissocarpha*, *H. undulata*, *Lasiopetalum exiguum* ms, *Trymalium urceolare* and *Goodenia pinifolia*.

Phenology. Flowers September to November.

Conservation status. Listed as Priority Two (as *T. nuda* var. *spartea*) under Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora (Atkins 2008).

Etymology. The epithet *spartea* was apparently used by Bentham (1863) in reference to the dense, erect and almost leafless stems of this taxon, which is superficially similar to broom (e.g. *Spartium junceum*) in habit. The varietal epithet is retained here at species rank.

Affinities. Tetratheca spartea is evidently closely related to *T. nuda*, but can be easily distinguished by the following suite of characters: the long anther tube (1.3–1.6 mm compared with 0.35–0.5 mm long), which has a narrow orifice without a prominently longer inner lip; the ovary covered with

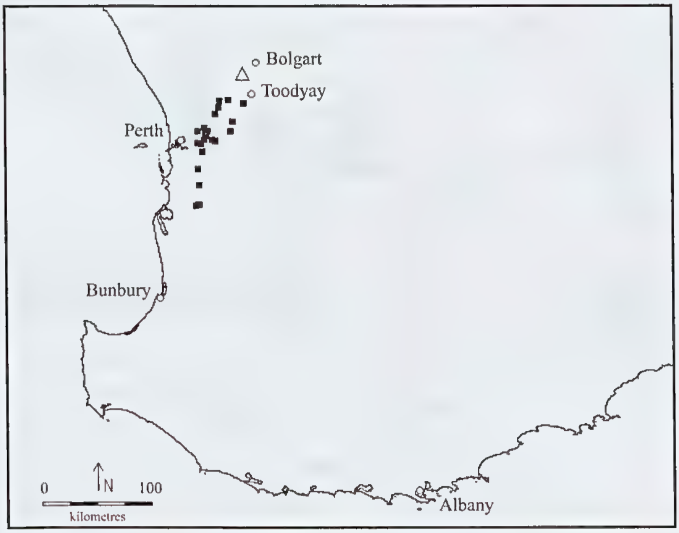

Figure 2. Distribution of *Tetratheca spartea* (△) and *T. nuda* (■) in south-west Western Australia.

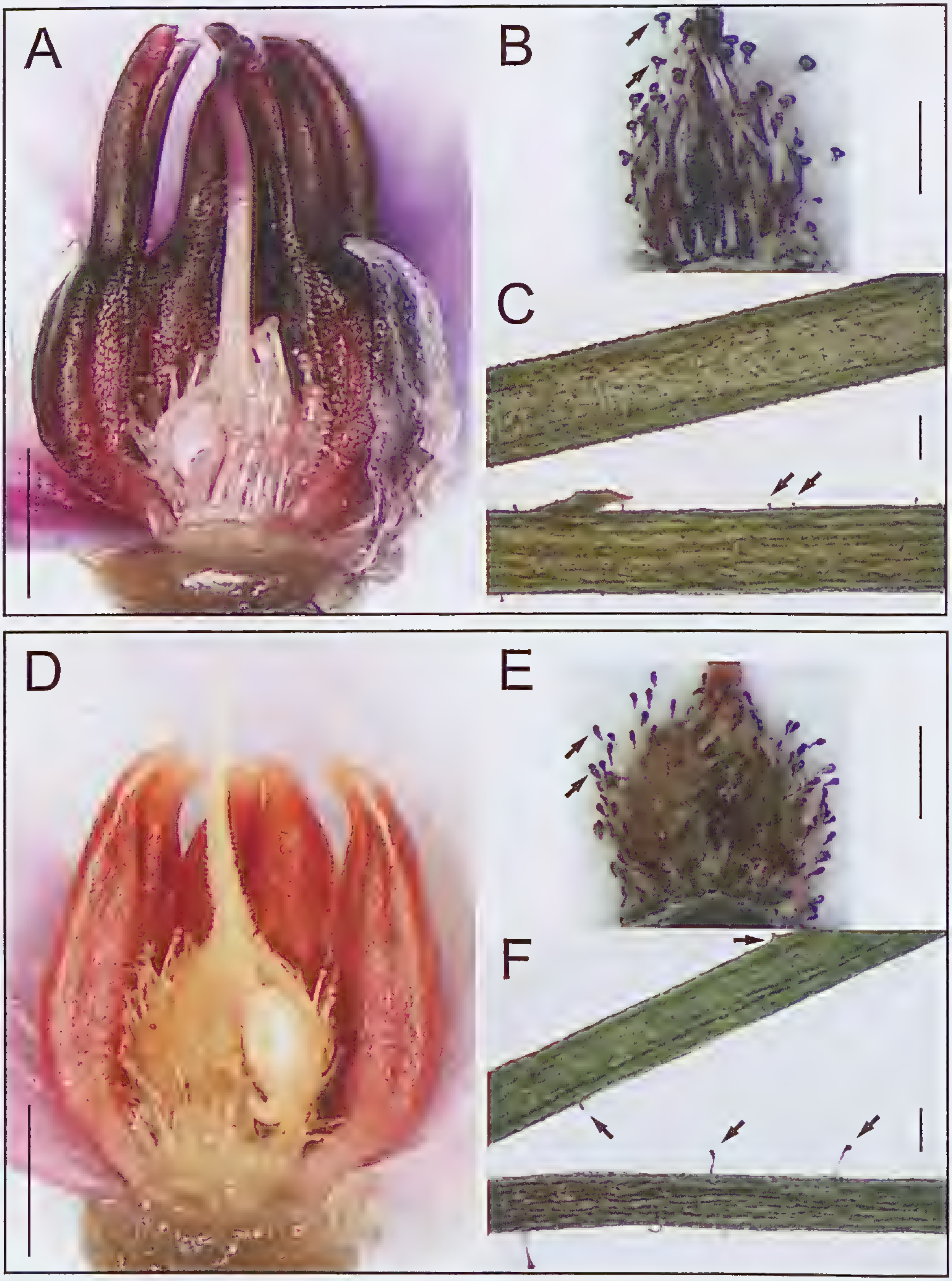

Figure 3. Comparative morphology of *Tetratheca spartea* (A–C; *R. Butcher*, *F. Hort & J. Hort* RB 1179) and *T. nuda* (D–F; *R. Butcher*, *F. Hort & J. Hort* RB 1189). A – dissected rehydrated flower showing elongate anther tubes, ±globular-headed glandular hairs on the ovary and glabrous style; B – dried ovary showing ±discoid-headed glandular hairs (arrowed); C – mature (upper) and young (lower) stems showing papillae and minute glandular hairs (arrowed); D – dissected rehydrated flower showing short anther tubes and orifices with elongate lower lip, ovary with both simple and glandular hairs and pubescent style base; E – dried ovary showing ±ellipsoid-headed glandular hairs (arrowed); F – mature (upper) and young (lower) stems showing longer glandular hairs and remnant bases (arrowed). Scale = 1 mm (A, D); 0.5 mm (B, C, E, F).

glandular hairs only (rather than both simple and glandular hairs), which are stouter with ±globular glandular tips which are broader than long and appear ±discoid when dried (rather than being ±elliptic in both the fresh and dried states); the glabrous style (rather than pubescent to 1/3 length); and slightly thicker stems (0.7–1.2 mm compared with 0.5–0.9 mm wide in the flowering region) with much shorter glandular hairs (to 0.1 mm compared with 0.2–0.5 mm long), which do not leave a noticeable remnant (Figure 3).

Tetratheca applanata is very similar to *T. nuda* in having slender, terete, leafless stems with long glandular hairs which leave a distinct remnant, as well as glandular hairs on the pedicel, receptacle and calyx segments, and the ovary densely covered with simple hairs and sparser, slender glandular hairs. This species differs from both *T. nuda* and *T. spartea* in stamen morphology; having the anther tube 0.6–1 mm long and the lower part of the anther body flattened and similar to the filament (Butcher 2007, Figure 7), as is seen in *T. paucifolia* Joy Thomps., as well as in having spathulate to narrowly obovate petals. *Tetratheca angulata* has stamens with similar dimensions to *T. nuda*, but is distinctive in this group in having compressed to quadrate stems and only simple hairs on the ovary.

Although Mueller (1882) placed *T. spartea* (as *T. nuda* var. *spartea*) under *T. virgata*, this latter species is distinctly different and can be distinguished by the following suite of characters: typically 4-merous flowers; frequent possession of slender, retrorse setae on stems; longer leaves with strongly revolute margins; glabrous ovary; and longer stamens (4.5–5 mm long), which are either glabrous or lightly tuberculate (rather than pubescent) and have longer filaments (*c.* 1 mm long), a prominent out-curving of the base of the anther body on the outer surface and anther tubes which are usually yellow and are longer (*c.* 2 mm long) and broader, with a broader orifice.

Notes. Habitat notes on *Tetratheca nuda* specimens indicate that this species is associated with granite substrates and in close proximity to granite outcrops. *Tetratheca spartea* has only been collected from areas at the base of lateritic breakaways, and this may indicate habitat specificity for the latter taxon. Further searches for this taxon should concentrate on similar habitat within the region.

Key to species of 'leafless' *Tetratheca* in Western Australia (amended from Butcher 2007)

1. Plants with a generally leafless aspect, although some leaves may be present 2

1: Plants leafy .... **group not addressed here**

2. Stems winged. Ovules 1 to 5 per loculus (Yallingup, Balingup to Cape Riche) .... **T. affinis**

2: Stems terete or tri- to quadrangular in cross-section. Ovules 1 or 2 per loculus. 3

3. Ovules typically 1 per loculus. 4

4. Pedicels and calyx densely pubescent, pedicels less than 5 mm in length. 5

5. Pedicels and calyx hispid with few small, red, glandular hairs. Leaf margins flat (NE Southern Cross, Newdegate) .... **T. aphylla**

5: Pedicels and calyx hispid with numerous large, red glandular hairs, these frequently bearing small, simple hairs towards their base. Leaf margins loosely revolute. 6

6. Stems 0.8–0.9 mm broad in the flowering region. Anther body 1.9–2.5 mm long with the lowest 0.6–1 mm extremely flattened and resembling the 0.6–1 mm long filament (Beverley to Arrino) .... **T. paucifolia**

6: Stems 1.7–1.9 mm broad in the flowering region. Anther body 2.5–2.6 mm long, not flattened in the lower region, curved at base abaxially and abruptly meeting the 1.1–1.8 mm long filament (Eneabba) .... **T. nephelioides**

4: Pedicels and calyx glabrous or with occasional glandular hairs, pedicels 5 mm or more in length. **7**

7. Stems glabrous or very sparsely glandular hairy. Ovary pubescent to sericeous, with or without additional glandular hairs, or with glandular hairs only. Anther tube 0.35–1.6 mm long.

8. Stems compressed to quadrangular (Badgingarra to Eneabba) .... **T. angulata**

8: Stems terete **9**

9. Ovary covered with stout glandular hairs only. Style glabrous. Anther tube 1.3–1.6 mm long (NW Toodyay) .... **T. spartea**

9: Ovary with a dense covering of simple hairs as well as slender glandular hairs. Style pubescent at base. Anther tube 0.35–1 mm long **10**

10. Body of anther flattened in lower third, filament 0.6–1.4 mm long, tube 0.6–1 mm long (Scattered; Dardadine, Broomehill, Ravensthorpe) .... **T. applanata**

10: Body of anther not flattened towards base, filament 0.2–0.35 mm long, tube 0.35–0.5 mm long (Darling Scarp) .... **T. nuda**

7: Stems usually with fine to coarse, scattered to dense setae, occasionally glabrous. Ovary glabrous. Anther tube 1.5–2.5 mm long **11**

11. Stems densely covered with patent, stout setae arising from broad tubercles. Leaves small (1.9–6.2 mm long) with flat, sparsely dentate and/or glandular hairy margins (NE Southern Cross) .... **T. harperi**

11: Stems glabrous or finely setose, setae reflexed to retrorse when present and arising from small tubercles. Leaves large (2–15.5 mm long) with revolute, glabrous margins. **12**

12. Leaf-blades tapered at the base. Anther filaments stout, *c.* 1 mm long (E side Darling Scarp, York to Albany) .... **T. virgata**

12: Leaf-blades broad at the base. Anther filaments slender, *c.* 0.5 mm long (Mt. Lesueur) .... **T. remota**

3: Ovules typically 2 per loculus. **13**

13. Stems densely covered in broad tubercules bearing patent, stout, somewhat senescent setae. Petals white to pale pink with dark pink spots or pale mauve (NE Southern Cross) .... **T. erubescens**

13: Stems smooth to minutely tuberculate, usually glabrous or with scattered glandular hairs or retrorse setae. Petals uniformly dark or mauve-pink, occasionally white. **14**

14. Anther tube 2.5–3 mm long with a conspicuously 2-lipped orifice (Tammin to Norseman) .... **T. efoliata**

14: Anther tube 0.6–2 mm long, the orifice oblique or with a longer inner lip **15**

15. Base of the plant usually covered with strongly retrorse, dark coloured setae. Pedicels glabrous, pink-green to pink-red, 7–16 mm long. Leaves with revolute margins (Wongan Hills to Katanning) .... **T. retrorsa**

15: Base of the plant lacking strongly retrorse, dark coloured setae. Pedicels scabrous to hispidulous, often with scattered, small glandular hairs, glossy green-red, 1–11 mm long. Leaves without revolute margins. **16**

16. Stems minutely tuberculate with scattered glandular hairs. Calyx segments broadly elliptic (Carnarvon Range) .... **T. chapmanii**

16: Stems densely covered with rounded to truncate tubercles. Calyx segments narrowly triangular to lanceolate (NE Southern Cross) .... **T. paynterae**

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Atriplex eremitis (Chenopodiaceae), a new species from northern Western Australia

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Abstract

Cranfield, R.J. *Atriplex eremitis* (Chenopodiaceae), a new species from northern Western Australia. *Nuytsia* 18: 49–52 (2008). A new saltbush species from the Pilbara region of Western Australia, *Atriplex eremitis* Cranfield, is described and mapped. Comparisons are made to the presumed closest species, *A. cinerea* Poir. and *A. amnicola* Paul G.Wilson, and an amendment to the key to *Atriplex* species in *Flora of Australia* is provided.

Introduction

The new taxon described here is known only from a localised population occurring in an area of semi-saline soil on the pastoral property, De Grey Station in the Pilbara region of Western Australia. It was considered an undescribed species in 1997 after examination of material collected during a survey (Van Vreeswyk *et al*. 2004) of the pastoral lease and was given the phrase name *Atriplex* sp. De Grey (A.A. Mitchell PRP1940).

Atriplex has been covered relatively recently in the *Flora of Australia* (Wilson 1984), from which it appears that its closest relatives are in the sect. *Dialysex* Moq.

Taxonomy

Diagnostic characters of the closely related species of *Atriplex* separate *A. eremitis* from the others, principally on bracteole size and the presence or absence of a stipe (Table 1). The leaves of *A. cinerea* Poir. are much larger and are densely clustered whereas those of *A. eremitis* Cranfield are considerably smaller and are sparsely clustered. There is a difference in the distribution ranges of the two species, with *A. cinerea* a southern coastal species. Another species that has a similar northern distribution as *A. eremitis* but differs in having leaves that are occasionally hastate at the base is *A. amnicola* Paul G.Wilson. The leaves of the latter are also very densely clustered and the fruits are stipitate, a character shared with *A. cinerea*. *Atriplex eremitis* differs from both species in having much smaller fruiting bracteoles (Table 1).

Table 1. Characters distinguishing *A. eremitis* from related *Atriplex* species.

Character	*A. eremitis*	*A. cinerea*	*A. amnicola*
Leaf			
Outline	entire	entire	entire-hastate
Length (mm)	4–16	25–40	10–25
Lamina shape	elliptic-oblong	elliptic-ovate	elliptic-oblong
Lamina base	attenuate	rounded	cuneate-hastate
Fruiting bracteole			
Attachment	sessile	stipitate-subsessile	sessile
Length (mm)	1.5–2	6–10	6–10
Width (mm)	1.5–2	6–10	4–6

Atriplex eremitis Cranfield, *sp. nov.*

Atriplex cinereae Poir. affinis sed statura parviore, bracteolis sessilibus 1.5–2 mm longis, et foliis sparsis differt.

Typus: De Grey Station [precise locality withheld for conservation reasons], 28 August 1997, *A.A. Mitchell* PRP1940 (*holo*: PERTH 04867610).

Erect, open sub-shrub to 30 cm high, monoecious or dioecious. Branches slender, smooth, with pale, buff- coloured bark. Leaves widely spaced along branches; lamina thin, narrowly elliptic to oblong, obtuse, attenuate at base, 4–16 × 2–6 mm, vesiculate with a grey scurfy appearance on both surfaces. Male flowers in glomerules *c.* 2 mm diameter, forming a short panicle. Female flowers in axillary clusters without associated male glomerules or occasionally the basal portion of an interrupted spike subtending male glomerules. Fruiting bracteoles 1/3 united, sessile, scurfy, rhomboid to deltoid, 1.5–2 × 1.5–2 mm, with 3 obtuse lobes. Seed circular, *c.* 1 mm diameter; testa faintly reticulate, cream to brown; radicle lateral, erect.

Distribution. Known only from the type locality on De Grey Station, Western Australia (Figure 1). This locality is a coastal portion of the Eremaean Botanical Province (Beard 1980) and is within the Pilbara Bioregion (Thackway & Cresswell 1995).

Habitat. Tussock grassland associated with *Eragrostis xerophila* Domin and the introduced *Cenchrus ciliaris* L. occurring as a component of a sub-unit of the Anna land system composed of level sand plains and a mosaic of saline plains (Van Vreeswyk 2004).

Flowering time. The only collection of this species was flowering in August.

Conservation status. Recently listed as Priority One under Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora. Additional surveys are required to determine whether this species warrants endangered status.

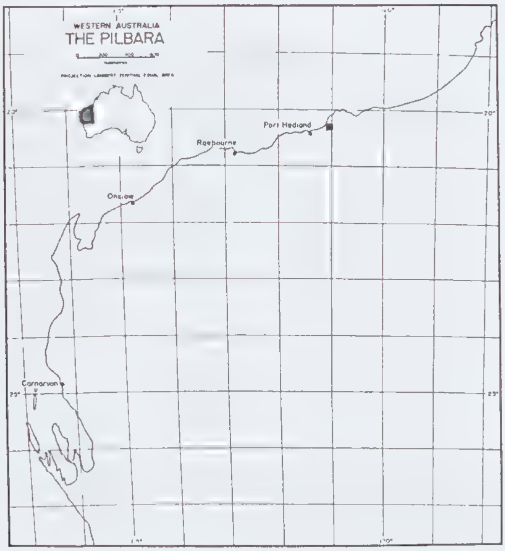

Figure 1. Distribution of *Atriplex eremitis* (■) in Western Australia.

Etymology. From the Greek *eremia* (desert, solitude) referring to the desert location and recluse nature of this species.

Notes. Although considered to be essentially dioecious, there is a degree of uncertainty as to whether this species is instead monoecious. Both male and female flowers were found on the material examined but the presence of male flowers was more obvious. It has been noted on several other monoecious species that occasional female flowers can occur on predominantly male plants and that this collection may not have sampled a female plant. Additional collections of this species can be expected to resolve this issue.

Amendments to the key to *Atriplex* species in *Flora of Australia*

For *Atriplex eremitis* the key for sect.V *Dialysex* (p. 90) should be altered to read from couplet 12:

12: Plant dioecious; leaves scurfy or scaly on both surfaces
12a Leaves 25–40 mm long, bracteole 6–10mm long..**A. cinerea**
12a: Leaves 4–16 mm long, bracteoles 1.5–2 mm long ....**A. eremitis**

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Further new taxa in *Banksia* (Proteaceae: Grevilleoideae)

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Abstract

George, A.S. Further new taxa in *Banksia* (Proteaceae: Grevilleoideae). *Nuytsia* 18(1): 53–59 (2008). Three new taxa are described: *Banksia ashbyi* Baker f. subsp. *boreoscaia* A.S.George, *B. incana* A.S.George var. *brachyphylla* A.S.George and *B. sphaerocarpa* R.Br. var. *pumilio* A.S.George. The taxon described as *B. sphaerocarpa* var. *latifolia* F.Muell. ex Benth. (1870) and later placed in synonymy under var. *sphaerocarpa* has recently been rediscovered and is again recognised as an accepted taxon.

Introduction

In preparation for a new book on *Banksia* L.f., three new taxa are described. They have been known for many years and included within the range of variation in named taxa but are now, following further research, deemed worthy of formal recognition. Also, an early name is resurrected for collections previously included within the variation of *Banksia sphaerocarpa* R.Br. var. *sphaerocarpa*. Significant variation remains in several taxa but very detailed work is required (beyond the scope of this study) to determine whether distinct taxa can be recognised within them. They include, in particular, *B. marginata* Cav. which has arborescent and shrubby forms, fire-tolerant and fire-sensitive forms, as well as variation in leaf and follicle morphology. Several other species have populations of both arborescent and shrubby form: notably *B. aemula* R.Br., *B. attenuata* R.Br., *B. grandis* Willd., *B. ilicifolia* R.Br., *B. integrifolia* L.f., *B. littoralis* R.Br. and *B. menziesii* R.Br., but there are intermediate forms, and the species' response to fire is constant.Yet others (notably *B. media* R.Br., *B. occidentalis* R.Br.) have shrubby inland forms with low-growing coastal forms that sometimes retain their low habit in cultivation. In the case of *B. saxicola* A.S.George, a low habit on the exposed summits of The Grampians grades to tall shrubs in sheltered valleys, and on Wilson's Promontory it is a tree; again, their fire-response is constant, and there appear to be no morphological characters by which formal taxa might be distinguished.

Banksia ashbyi Baker f., *J. Bot.* 72: 281 (1934). *Type*: near Yuna, Western Australia, *c.* 1930, *E. Ashby, Herb. A. Morris* 2537 (*lecto*: BM; *isolecto*: AD).

Banksia ashbyi Baker f. subsp. **ashbyi**

Shrub or *tree* to 7 m, without lignotuber, fire-sensitive. *Leaves* commonly deep green.

Selected specimens examined. WESTERN AUSTRALIA: Kennedy Range, 11 Aug. 1981, *R.J. Cranfield* 1918 (PERTH); E of Yuna, 14 May 1961, *A.S. George* 2394 (PERTH); *c*. 60 km S of Billabong Roadhouse, North West Coastal Hwy, 30 Sep. 1985, *N. Hoyle* 673 (CANB, PERTH); between Tamala and Nilemah Station, 20 July 1988, *P. Morat* 8254 (P, PERTH).

Distribution. Western Australia, between Shark Bay and Coorow, and in the Kennedy Range.

Habitat. In deep sand with tall shrubland

Flowering period. Any month but mainly winter.

Conservation status. Not rare or endangered.

Banksia ashbyi subsp. **boreoscaia** A.S.George, *subsp. nov.*

Frutex ad 2 m alta, lignotubero. Folia semper griseo-viridia.

Typus: Quobba Point, north of Carnarvon, Western Australia, 24° 29' S, 113° 25' E, 15 October 1975, *K.F. Kenneally* 4704 (*holo*: PERTH 01722433; *iso*: CANB, K).

Sprawling *shrub* to 2 m, with lignotuber. *Leaves* consistently grey-green.

Selected specimens examined. WESTERN AUSTRALIA: SE of 5 Mile Well, Cape Range, 26 May 1965, *Y. Chadwick* 2287 (PERTH); Day Centre, Yardie Creek, 16 May 2006, *J. English* 13 (PERTH); *c*. 1.5 km E of [Vlaming Head] lighthouse, North West Cape, 31 Dec. 1960, *A.S. George* 2299 (CANB, PERTH); 15 km N of Ningaloo Homestead on road to Yardie Ck, 30 July 1980, *K.F. Kenneally* 7360 (PERTH).

Distribution. Western Australia, between North West Cape and Quobba.

Habitat. Coastal dunes and on some red dunes of the Cape Range, growing in low shrubland.

Flowering period. Any season but mainly winter.

Conservation status. Not rare or endangered.

Etymology. From the Greek *borealis* (northern) and *skaios* (west, left-hand), in reference to the occurrence in the north-west of Western Australia. It is the only taxon of the genus in this region.

Discussion. Although there is no morphological feature in foliage, flowers or fruit to distinguish the populations north of Carnarvon from those south of Shark Bay, the consistent difference in habit (fire-tolerant contrasted with fire-sensitive) gives them a distinctive appearance that is retained in cultivation. This differs from the situation in other species with tall and short variants (e.g. *B. media*, *B. seminuda* (A.S.George) Rye, *B. serrata* L.f.) in which the fire response is consistent.

Banksia incana A.S.George, *Nuytsia* 3: 441 (1981). *Type*: 'Outside Mogumber Mission', Western Australia, *c.* 31° 00' S, 115° 56' E, 2 February 1967, *A.S. George* 8644 (*holo*: PERTH 01580523; *iso*: AD, BRI, CANB, K, MEL, NSW, PERTH 01580531, RSA).

Banksia incana A.S.George var. **incana**

Typically a rather open *shrub*. *Leaves* usually 30–50 mm long, sometimes to 60 mm.

Selected specimens examined. WESTERN AUSTRALIA: Cadda Rd near NW corner Badgingarra National Park, 26 Mar. 1977, *A.S. George* 14411 (PERTH); Sultana Rd, Forrestfield, 16 Nov. 1992, *G.J. Keighery* 12749 (PERTH); Hi Vallee, 10 July 1999, *M. Hislop* 1370 (PERTH); near Eneabba, 15 Nov. 1996, *A.R. Mast* 357 *& D.S. Feller* (PERTH, WIS).

Distribution. Western Australia, between Arrowsmith and Mogumber, with disjunct populations near Gingin and Perth.

Habitat. In deep sand and sand over laterite, in kwongan and low open woodland.

Flowering period. Autumn and winter.

Conservation status. Not rare or endangered.

Banksia incana var. **brachyphylla** A.S.George, *var. nov.*

Ab *Banksia incana* A.S.George var. *incana* foliis brevioribus (plerumque 10–20 mm longis) differt.

Typus: Big Soak Plain, Coorow–Green Head Road, Western Australia, 30° 05' S, 115° 37' E, *M.A. Langley* 2207 *& L.W. Sage*, 23 November 1999 (*holo*: PERTH 06393470).

Typically a mounded *shrub*. *Leaves* usually 10–20 mm long, commonly shorter, occasionally to 25 mm.

Selected specimens examined. WESTERN AUSTRALIA: near Badgingarra, Apr. 1963, *R. Aitken s.n.* (PERTH); Coomallo Ck, 15 Dec. 1976, *R.J. Hnatiuk* 761395 (PERTH); E boundary of Badgingarra National Park, 9 km SW of Badgingarra, 27 Mar. 1984, *S.D. Hopper* 3602 (PERTH); opposite Marchagee Track turnoff, Brand Hwy, 1 Dec. 1977, *B. Jack s.n.*(PERTH).

Distribution. Western Australia, from Badgingarra National Park to Alexander Morrison National Park and Big Soak Plain (SW of Coorow).

Habitat. In deep sand, shallow sand over laterite or lateritic gravel, in kwongan.

Flowering period. Early summer to early winter.

Conservation status. Not rare or endangered.

Etymology. From the Greek *brachys* (short) and *phyllum* (a leaf), in reference to the leaves.

Discussion. Geographically the taxon occurs to the east of the northern distribution of typical *B. incana* but there is one record of var. *incana* farther north-east. The two varieties sometimes occur close together (within 10 km along Coorow–Green Head Road east of the Brand Highway) but have not been recorded growing sympatrically. They grow in similar habitats. Usually var. *brachyphylla* is a low, mounded shrub, in contrast to the more open, erect habit of typical *incana*. In its extreme form the leaves are all below 15 mm long, giving the plant a 'heath-like' aspect. It is variable in leaf width, from 1 mm to 2 mm wide. In several collections the leaves are intermediate in length between the two forms, e.g. *A. Strid* 21738, 18–20 km W of Mogumber (PERTH) which has leaves 15–35 mm long. In keeping with my concept of the ranks of subspecies and variety (George 1996: 314), it is more appropriate to recognise the taxa as varieties rather than subspecies.

Banksia sphaerocarpa R.Br., *Trans. Linn. Soc. London* 10: 203 (1810). *Type*: Just north of King George Sound, [Western Australia], December 1801, *R. Brown* (*lecto*: BM; *isolecto*: BM).

Banksia sphaerocarpa is one of the most varied and widely distributed western banksias. It occurs from the Eneabba district south to the Whicher Range and Albany and east to the Ironcaps (east of Lake King). In habit it is a lignotuberous shrub but ranges from a small, sprawling plant to a rounded plant up to 3 m tall and 4 m wide. There is variation in the size of leaf, flower and fruit. Some of this variety has already been captured in the formal recognition of three varieties, var. *sphaerocarpa*, var. *caesia* A.S.George and var. *dolichostyla* A.S.George. A varietal name published by George Bentham (based on a manuscript name of Ferdinand Mueller) – var. *latifolia* – was synonymised by George (1981) under var. *sphaerocarpa* pending its rediscovery and hence availability of more comprehensive material. The variant has been rediscovered recently and differs consistently from typical var. *sphaerocarpa* in the short, broad leaves and in having a low, dense, mounded habit. It is here restored as an accepted taxon. Of other variants in the species the populations that occur from the Chittering district northwards are also recognised here as a variety, having consistently shorter flowers than var. *sphaerocarpa*. Several recent collections from and near Jilbadgi Reserve east-south-east of Merredin (e.g. *M. Mikli* 1635, PERTH) have flowers in the lower end of the size range of var. *dolichostyla* but one is intermediate in size between var. *caesia* and var. *dolichostyla*. Further study of these populations is required, but they appear to confirm the close relationship between the varieties.

Key to varieties of *Banksia sphaerocarpa*

1. Perianth 49–55 mm long; pistil 50–65 mm long.......................... var. **dolichostyla**
1: Perianth 20–39 mm long; pistil 22–46 mm long

2. Leaves 2–2.5 mm wide, obtuse with blunt mucro.......................... var. **latifolia**
2: Leaves 1–1.5 mm wide, acute with pungent mucro

3. Perianth 20–25 mm long; pistil 22–31 mm long.......................... var. **pumilio**
3: Perianth 30–39 mm long; pistil 35–46 mm long

4. Follicles commonly 15–30 mm long; leaves usually mid to deep green; perianth usually brown.......................... var. **sphaerocarpa**
4: Follicles commonly 8–17 mm long; leaves usually blue-green; perianth usually golden .... var. **caesia**

Banksia sphaerocarpa R.Br. var. **sphaerocarpa**

Typically a *shrub* 1–2 m tall. *Leaves* linear, acute, 2.5–10 cm long, *c.* 1.5 mm wide. *Perianth* 30–39 mm long. *Pistil* 35–46 mm long. *Follicles* 15–30 mm long, 10–25 mm wide.

Selected specimens examined. WESTERN AUSTRALIA: 1.5 km along Chillinup Rd from [Albany–] Chester Pass Rd, 18 Feb. 1998, *L.W. Cayzer* 551, *G.T. Chandler & S. Donaldson* (CANB, NSW, PERTH); Yeriminup Rd, west of Cranbrook, 17 Feb. 1997, *R. Davis* 2549 (PERTH); Old Yornup Rd, off Seaton Ross Rd, Yornup, 4 June 2002, *D. Foster* 66 (PERTH); 6–7 km W of Cape Riche, 29 Mar. 1964, *A.S. George* 6160 (PERTH); track to summit, Mt Lindesay, 3 Feb. 1980, *J.M. Powell* 1438 (NSW, PERTH); *c.* 25 km E of Collie, 20 July 1967, *E.M. Scrymgeour* 2065 (PERTH).

Distribution. Western Australia, from the Darling Plateau east of Perth south to the Whicher Range and east to the Stirling Range and Cape Riche.

Habitat. Grows in laterite or sandy loam over laterite, in forest or woodland of *Eucalyptus marginata*, mallee open shrubland and kwongan.

Flowering period. Mostly autumn and winter.

Conservation status. Not endangered but several variants appear rare.

Discussion. As mentioned in George (1981, 1999), this taxon shows much variation. Noteworthy variants include one from the Whicher Range with large follicles that have a quite acute ridge while closed. Several collections from the Jarrah forest also have large follicles. One from near Nannup (*A.S. George* 17516, PERTH) has short, broad leaves but is a small, sprawling plant (unlike var. *latifolia*, see below); it has large, sharp-edged follicles like the Whicher Range variant. There is a similar collection but without fruit from south-south-east of Rocky Gully, *A.R. Annels* 3692 (PERTH).

Banksia sphaerocarpa R.Br. var. **pumilio** A.S.George, *var. nov.*

Ab varietibus aliis *Banksiae sphaerocarpae* habitu plerumque minori, floribus brevioribus et folliculis plerumque majoribus differt. Frutex minus quam 1 m altus. Perianthium 20–25 mm longum. Pistillum 22–31 mm longum. Folliculi 20–30 mm longi, 15–25 mm lati.

Typus: *c.* 6 km north of Badgingarra, Western Australia, *c.* 30° 22' S, 115° 33' E, 11 April 1964, *A.S. George* 6185 (*holo*: PERTH 01757903; *iso*: PERTH 01757881).

Typically a *shrub* less than 1 m tall. *Perianth* 20–25 mm long. *Pistil* 22–31 mm long. *Follicles* 20–30 mm long, 15–25 mm wide.

Selected specimens examined. WESTERN AUSTRALIA: Mogumber Mission [i.e. *c.* 10 km W of Mogumber], 12 Apr. 1964, *A.S. George* 6200 (PERTH); 67 mile peg, Great Northern Hwy [i.e. Uduming Brook Nature Reserve, N of Bindoon], 10 June 1966, *A.S. George* 7767 (PERTH); Tathra National Park, 27 Mar. 1977, *A.S. George* 14423 (PERTH); Hi Vallee farm [N of Badgingarra], 30 Apr. 2000, *M. Hislop* 1989 (PERTH); S of Mimegarra Rd [turnoff] on Brand Hwy, 10 July 1988, *B.J. Keighery* 127B (PERTH); Big Soak Plain, Warradarge, 21 Sept. 2005, *K. Pearce* 15 (PERTH).

Distribution. Western Australia, from Tathra National Park east of Eneabba south to the Chittering valley.

Habitat. Shallow sand or clay-loam over laterite, in kwongan (sometimes with emergent mallee eucalypts) and low open forest of *Eucalyptus marginata* and *E. calophylla*, usually on mid to upper slopes in landscape

Flowering period. Mostly late autumn to mid winter.

Conservation status. Not rare or endangered.

Etymology. From the Latin *pumilio* (small), in reference to the flowers.

Discussion. Typically this has leaves 2–4 cm long but occasionally 5–6 cm, e.g. Mullering Road near Dandaragan, *E.R. Minty* 12 (PERTH); *c*. 15 km N of Moora, *B. Morgan* 148 (PERTH). In follicle size this sometimes approaches *B. micrantha* A.S.George. The follicles are flattened (while retaining the transverse 'shoulders' that characterise *B. sphaerocarpa*), in contrast to the large-follicle variant of var. *sphaerocarpa* from the Whicher Range.

Banksia sphaerocarpa var. **latifolia** F.Muell. ex Benth., *Fl. Austral*. 5: 546 (1870).

Type: Porongurup Range, Western Australia, *s. dat*., *G. Maxwell* (*lecto*: MEL; *iso*: MEL; probable *isolecto*: PERTH 01757725).

Typification. The specimen at PERTH considered a probable isolectotype is on a sheet ex MEL that bears three collections, all attributed to James Drummond with the number 1: 648. Two specimens in leaf (PERTH 01757733) are *B. telmatiaea* A.S.George and are probably this number since duplicates are in other herbaria such as P. Another specimen in late bud (PERTH 01757717) is *B. incana*, probably *Drummond* 337 as it agrees with specimens under this number at K. The third specimen (PERTH 01757725) is in mid-bud and has short, broad leaves (10–30 mm long, 2–2.7 mm wide); it agrees with the Maxwell collection at MEL on which var. *latifolia* is based.

Shrub to 50 cm tall, much-branched and dome-like. *Leaves* 11–38 mm long, 2–2.7 mm wide, rounded at apex with a very short obtuse mucro. *Perianth* 33–37 mm long, very hirsute. *Pistil* 41–45 mm long. Follicles 15–22 mm long, 12–15 mm wide.

Specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] May 2006, *K. Collins* (PERTH); May 2007, *K. Collins* (PERTH).

Distribution. Western Australia, Mt Barker district.

Habitat. In granitic clay-loam in low, open forest of *Eucalyptus marginata* and *E. calophylla*, usually on mid to upper slopes in landscape

Flowering period. Mostly late autumn to mid winter.

Conservation status. Recently listed as Priority Two under Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora. Known from few populations and one contains several hundred plants.

Discussion. This variant has recently been rediscovered and cultivated by Kevin Collins at The Banksia Farm, Mt Barker, Western Australia Besides the short, broad leaves it has a very compact, dome-like habit and is sufficiently distinct to warrant recognition as a valid taxon. It is known only from the Mount Barker area. Four collections at PERTH from the same region also have short leaves but these are very narrow like typical var. *sphaerocarpa*: King George Sound, 1901, *B.T. Goadby*; Boulder Hill, Betty Beach, *G.J. Keighery* 8248; Denbarker, *'Survey Team 1608'*; and Mt Lindesay, *J.M. Powell* 1438. The last two of these were noted as shrubs to 60 cm tall.

Acknowledgements

Over the years I have discussed these banksias with a number of people including Kevin Collins, Cas Liber, George Lullfitz and Don Williams and am grateful for their input. An anonymous referee gave constructive comments.

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Three new species of *Leucopogon* (Ericaceae: Styphelioideae: Styphelieae) from the far south-west of Western Australia

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Abstract

Hislop, M. Three new species of *Leucopogon* (Ericaceae: Styphelioideae: Styphelieae) from the far south-west of Western Australia. *Nuytsia* 18: 61–78 (2008). Two new species, *Leucopogon altissimus* Hislop and *L. wheelerae* Hislop, are described. A third taxon, *L. richei* (Labill.) R.Br. var. *acutifolius* Benth., is elevated to species level under a new name, *L. interstans* Hislop, and with an expanded circumscription. All three are illustrated and their distributions mapped. Full descriptions of the species *L. alternifolius* R.Br. and *L. australis* R.Br., which are morphologically similar to *L. wheelerae* and *L. interstans* respectively, are given for purposes of comparison. Lectotypes are designated for the following taxa: *L. alternifolius* R.Br., *L. australis* R.Br., *L. interruptus* R.Br., *L. paniculatus* Sond., *L. polystachyus* R.Br. and *L. polystachyus* var. *serratifolius* Sond.

Introduction

Leucopogon R.Br. is the largest genus within Ericaceae subfamily Styphelioideae, a grouping which now accommodates all of the genera previously belonging to the family Epacridaceae (Kron *et al.* 2002). This reclassification retains the tribe Styphelieae in close to its original concept, to include all of the drupaceous genera except *Oligarrhena* R.Br. and *Needhamiella* L.Watson, which were transferred to the new tribe Oligarrhenae.

Recent molecular and morphological research (Taaffe *et al.* 2001; Quinn *et al.* 2003) has convincingly demonstrated that *Leucopogon s. lat.* is polyphyletic. Within this assemblage however, there is a large monophyletic species group that includes the type species, *L. lanceolatus* (Sm.) R.Br., and therefore represents *Leucopogon s. str.* The morphological characters that define *Leucopogon s. str.* are given in Hislop and Chapman (2007). In the absence of an adequate formal infrageneric classification for *Leucopogon s. str.*, the paper also included the delineation of five informal groups within the Western Australian members of the genus. Three new species from one of these groups, the *L. australis* R.Br. species group (Group A), were also described there. The current paper provides descriptions of another two new species from the group, *L. altissimus* Hislop and *L. wheelerae* Hislop, and elevates *L. richei* (Labill.) R.Br. var. *acutifolius* Benth., with an expanded circumscription, to species level under the new name *L. interstans* Hislop.

In the course of this research, many types relevant to the group were examined and where possible lectotypes have been designated.

Methods

This study is based on observations of herbarium collections housed at PERTH. Relevant type specimens were obtained on loan from BM and MEL, while images of others housed at K and G have also been examined. In the case of the type images from K, additional critical observations of the specimens themselves were provided by Juliet Wege, the 2005–06 Australian Botanic Liaison Officer.

Details of the methods used to measure plant parts and make other morphological observations are the same as those described previously in Hislop & Chapman (2007).

The distribution map was compiled using DIVA-GIS version 5.2.0.2 and based on PERTH specimen data.

Notes on lectotypifications

Two Australian taxonomists, W.-L. Chew and later J.M. Powell, were active in the study of the genus *Leucopogon* between the 1970s and the 1990s. During this period they examined type collections at the British Museum, and selected lectotypes for a number of *Leucopogon* species described by Robert Brown, but both later retired without effecting these lectotypifications.

The Brown lectotypes designated in this paper follow the intentions of these earlier authors, except in the case of *L. australis*, where Powell had nominated a specimen from the Port Dalrymple [Tasmania] gathering, while I have selected a sheet from the earlier King George Sound [Western Australia] material.

Taxonomy

Leucopogon alternifolius R.Br., *Prod. Fl. Nov. Holl.* 543 (1810). *Styphelia alternifolia* (R.Br.) Spreng., *Syst. Veg.* 1: 655 (1824). *Type*: Cape Howe [Western Australia], December 1801, *R. Brown s.n.* (*lecto*, here designated: BM 000929069!; *isolecto*: BM 000929070!, PERTH 04161130!)

Low, sprawling *shrubs* to 40 cm high and 40 cm wide, single stemmed at ground level with fire sensitive rootstock. Young *branchlets* very slender, pale brown or reddish-brown, glabrous, older stems overlain with fissured grey bark. *Leaves* spirally arranged, variably antrorse, ovate or broadly ovate, 2.3–6.1 mm long, 1.8–5.2 mm wide; apex acute and usually recurved; base cordate, often deeply so, ± stem clasping; petiole indistinct, greenish-yellow, to 0.3 mm long but mostly shorter, glabrous; lamina 0.1–0.2 mm thick, usually concave, often deeply so with the adaxial surface ± folded longitudinally, but becoming slightly recurved towards the margins, occasionally ± flat; surfaces discolorous, glabrous, adaxial surface slightly shiny, venation not or barely evident, abaxial surface paler with 7–9 primary veins and significant development of secondary veins, the midrib not differentiated; margins slightly thickened, entire or denticulate. *Inflorescence* erect, spreading or ± decurved, terminal and axillary, the latter extending down the flowering branchlets for many (sometimes as many as 20) nodes, occasionally the upper inflorescences branched; axis usually distinctly flexuose, glabrous, 3–9 mm long, with 3–11 flowers terminating in a bud-like rudiment, the flowers erect and sessile. *Fertile bracts* broadly ovate to ovate, 0.7–0.9 mm long, 0.6–0.9 mm wide, obtuse to subacute; abaxial surface with rather conspicuous venation, glabrous or papillose; adaxial surface sparsely appressed-hairy; margins minutely ciliolate. *Bracteoles* ovate, 0.5–0.8 mm long, 0.5–0.6 mm wide, subacute to acute, keeled; abaxial surface usually papillose about the keel, glabrous elsewhere, the central portion greenish or often suffused red-purple and the venation rather conspicuous, paler and scarious towards the margins; adaxial surface appressed-hairy in basal half; margins minutely ciliolate. *Sepals* narrowly ovate to ovate, 1.0–1.5 mm long, 0.4–0.7 mm wide, acute; abaxial surface usually papillose, the central portion greenish, often suffused purple, the venation especially the midrib rather conspicuous, pale, becoming scarious towards margins; adaxial surface with appressed hairs towards the apex; the margins minutely and irregularly ciliolate with hairs <0.05 mm long. *Corolla tube* white, broadly and shallowly campanulate, shorter than the sepals, 0.5–0.8 mm long, 1.2–1.4 mm wide, glabrous externally and internally. *Corolla lobes* white or pale pink, longer than the tube (ratio = 1.4–2.2:1), spreading widely from base, 1.0–1.4 mm long, 0.7–0.9 mm wide at base, glabrous externally, rather sparsely bearded internally, with the surface clearly visible between the hairs, indumentum white, 0.2–0.4 mm long near apex, glabrous tip *c.* 0.1 mm long. *Anthers* partially exserted from tube (by 2/3 to 3/4 of length), 0.4–0.7 mm long, slightly recurved at apex; sterile tips very obscure, 0.15–0.25 mm long; *filaments* terete, attached 1/2–2/3 above anther base, 0.3–0.4 mm long, adnate to tube just below sinus. *Ovary* globose, 0.3–0.4 mm long, 0.3–0.4 mm wide, papillose towards apex, 2- or 3-locular; *style* 0.3–0.4 mm long, tapering abruptly from base to the narrow apex, papillose, included within the corolla tube; *stigma* not expanded; *nectary* annular, 0.1–0.2 mm long, shallowly lobed, glabrous. *Fruit* usually compressed and ± circular, broadly elliptic or asymmetrically elliptic in outline when one or two ovules develop, occasionally trigonous when all three ovules develop, glabrous, 0.9–1.2 mm long, 0.7–1 mm wide, ± the same length or a little longer than calyx at maturity, the surface with a conspicuous raised reticulum; style persistent. (Figures 1A, B)

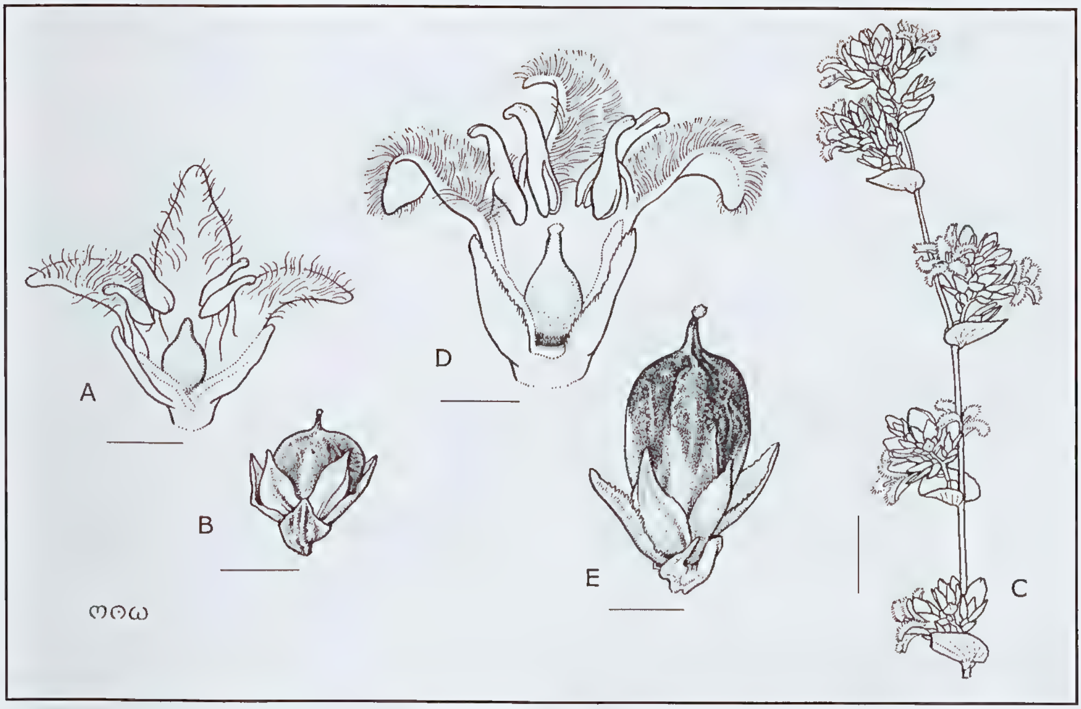

Figure 1. *Leucopogon alternifolius*. A – flower, longitudinal section; B – fruit. *Leucopogon wheelerae*. C – flowering branchlet; D – flower, longitudinal section; E – fruit. Scale bars: A, B, D, E = 1 mm; C = 5 mm. Drawn by Margaret Wilson from *A.R. Annels & R.W. Hearn* 4423 (A), *A.R. Annels* 1999 (B), *S. Paust* 254 (C, D), *M. Hislop* 3680 (E).

Other specimens examined. WESTERN AUSTRALIA: [localities withheld] 24 Dec. 1902, *Cecil Andrews* s.n. (PERTH); 20 Nov. 1991, *A.R. Annels* 1999 (CANB, PERTH); 14 Sep. 1994, *A.R. Annels & R.W. Hearn* 4423 (PERTH); 5 Nov. 1994, *B.G. Hammersley* 1275 (PERTH); 10 Sep. 1986, *G.J. Keighery* 8363 (CANB, PERTH); Aug. 1933, *A. Meebold* 11642 (PERTH); 1 Dec. 1988, *G. Wardell-Johnson* s.n. (PERTH).

Distribution and habitat. Occurs between Walpole and Albany (Figure 2), where it grows in and around swamps, in heath or occasionally open woodland.

Conservation status. Leucopogon alternifolius was previously included as a Priority taxon on the Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora but was removed in 1992, mainly as a result of the discovery of large, new populations on the Scott River Plains. These are now recognised as belonging to a separate species, *Leucopogon wheelerae* Hislop, described below. This has necessitated a re-evaluation of the conservation status of *L. alternifolius s. str.* The latter is currently known from relatively few populations, most of which are protected within the conservation estate. However with a restricted distribution in one of the wettest areas of southern Western Australia it may become vulnerable in the medium term if, as predicted, anthropogenic climate change leads to hotter and drier conditions across the species' range. Consequently *L. alternifolius* has been recently re-listed as Priority Three under DEC Conservation Codes for Western Australian Flora.

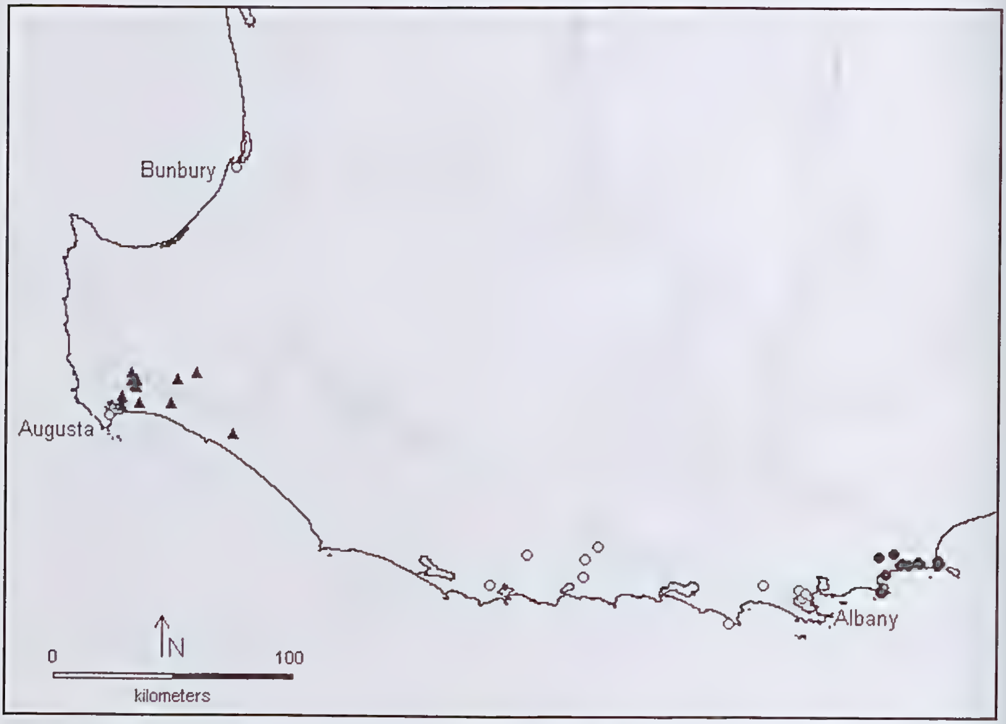

Figure 2. Distribution of *Leucopogon alternifolius* (○), *L. altissimus* (◉), and *L. wheelerae* (▲) in south-west Western Australia. *Interim Biogeographic Regionisation Version 6.1* (Department of the Environment, Water, Heritage and the Arts 2008) boundaries are indicated in grey.

Leucopogon altissimus Hislop, *sp. nov.*

Leucopogi parvifloro sed inflorescentia decurva et axe inflorescentiae glabro differt.

Typus: east of Albany, Western Australia [precise locality withheld for conservation reasons], 26 August 2006, *M. Hislop* 3635 (*holo*: PERTH 07467532; *iso*: CANB, K, MEL, NSW).

Tall, erect *shrubs* to *c.* 3 m high and 2 m across, single stemmed at ground level with a fire-sensitive rootstock. Young *branchlets* pale to copper brown, glabrous, older stems overlain with ± fissured grey bark. *Leaves* spirally arranged, antrorse, usually steeply so, narrowly elliptic to elliptic, 22–48 mm long, 6–13 mm wide; apex acute; base attenuate; petiole rather indistinct, similar in texture to the lamina, pale brown or yellow-brown, to 2 mm long, glabrous; lamina 0.15–0.25 mm thick, ± flat or very slightly convex adaxially; the surfaces discolorous, adaxial surface shiny, glabrous, with 5–7 flat or slightly sunken veins evident, abaxial surface paler, glabrous, striate, with 5–7 raised primary veins and many conspicuous, secondary veins, the midrib not differentiated; margins scabrous at least in the distal half with stiff antrorse hairs < 0.1 mm long. *Inflorescence* terminal and upper-axillary, mostly decurved, although some terminal inflorescences may be ± erect; axis usually distinctly flexuose, glabrous, 12–25 mm long, with 7–17 flowers, terminating in a bud-like rudiment or occasionally an attenuate point, the flowers sessile. *Fertile bracts* ovate, 0.8–1.4 mm long, 0.5–0.9 mm wide, obtuse; abaxial surface glabrous, with prominent venation; adaxial surface appressed-hairy; margins ciliolate. *Bracteoles* ovate, 1–1.3 mm long, 0.7–0.9 mm wide, subacute to acute, not or very obscurely keeled; abaxial surface glabrous, the central portion green occasionally flushed pink-purple towards the apex, becoming scarious towards the margins; adaxial surface shortly appressed-hairy; margins ciliolate. *Sepals* narrowly ovate to ovate, 1.6–2.4 mm long, 0.7–1.0 mm wide, obtuse to subacute; abaxial surface glabrous, greenish, the pale venation rather inconspicuous, becoming scarious towards the margins; adaxial surface appressed-hairy; the margins ciliolate with hairs *c.* 0.05 mm long. *Corolla tube* white, broadly campanulate, shorter than the sepals by up to 0.6 mm, 0.9–1.4 mm long, 1.2–1.6 mm wide, glabrous externally, mostly glabrous internally apart sometimes from a very sparse indumentum towards the top of the tube. *Corolla lobes* creamy-white, longer than the tube (ratio = 1.2–1.8:1), widely spreading from base and recurved, 1.6–2.1 mm long, 0.7–1 mm wide at base, glabrous externally, rather sparsely bearded internally with the surface readily visible between the hairs, very occasionally hairs reduced to papillae, indumentum white, 0.2–0.4 mm long near apex, the glabrous tip abruptly inflexed, 0.1–0.2 mm long. *Anthers* partially to almost completely exserted from tube (by at least 7/8 of length), 1–1.5 mm long, slightly recurved towards apex; sterile tips rather conspicuous, 0.3–0.5 mm long; *filaments* terete, attached 1/3 to a little over 1/2 above anther base, 0.5–0.7 mm long, adnate to tube just below sinus. *Ovary* ellipsoid, 0.5–0.6 mm long, 0.4–0.5 mm wide, glabrous, 3- or 4-locular; *style* 0.5–0.6 mm long, well defined, cylindrical for most of length; *stigma* not or only slightly expanded and presented at the top of the tube; *nectary* annular, 0.3–0.4 mm long, shallowly lobed for between 1/4 and 1/2 of length, glabrous. *Fruit* ellipsoid, with smoothly rounded shoulders, glabrous, 2.9–3.5 mm long, 1.9–2.1 mm wide, much longer than calyx, the surface with a raised reticulum of longitudinal and transverse ridges; style persistent. (Figure 3)

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 6 Oct. 1992, *A.R. Annels* 2571 (CANB, PERTH); 27 Aug. 2006, *M. Hislop* 3637 (CANB, PERTH); 27 Aug. 2006, *M. Hislop* 3642 (PERTH); 27 Aug. 2006, *M. Hislop* 3643 (HO, PERTH); 27 Aug. 2006, *M. Hislop* 3644 (CANB, NSW, PERTH); 28 Aug. 2006, *M. Hislop* 3649 (CANB, NSW, PERTH); 27 Aug. 1986, *J.M. Powell* 2663 (HO, NSW, PERTH); 13 Nov. 2004, *E.M. Sandiford* EMS 994 (NSW, PERTH); 29 Aug. 1972, *G.T. Smith & L.A. Moore s.n.* (PERTH).

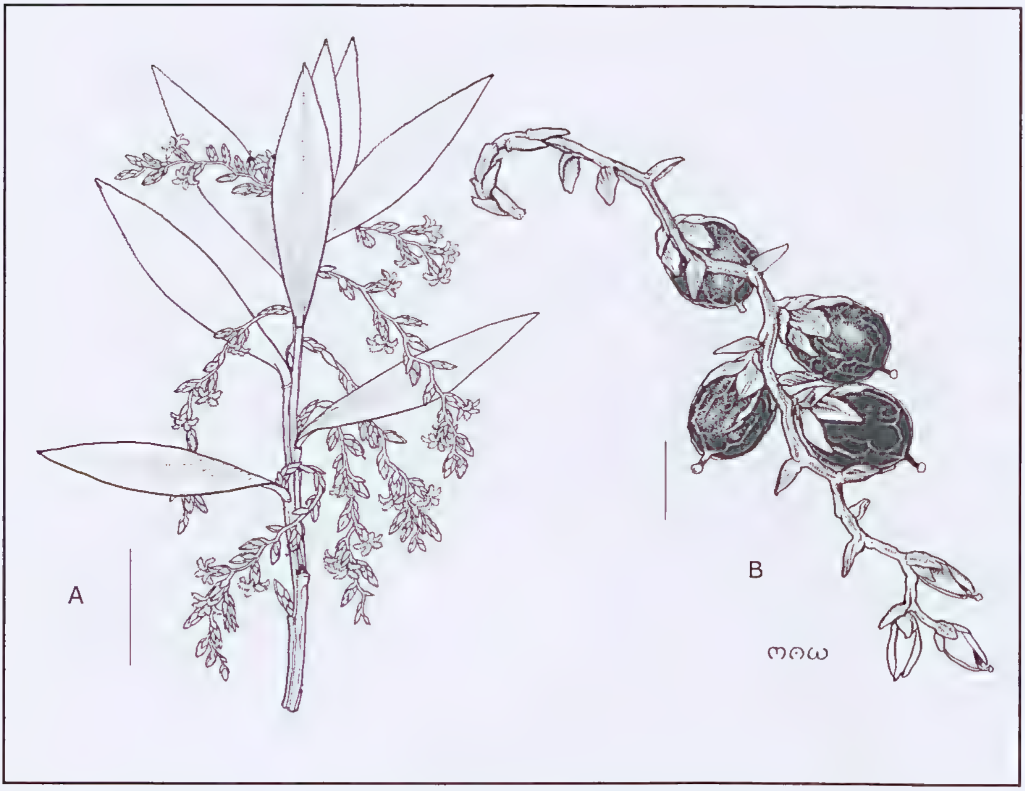

Figure 3. *Leucopogon altissimus*. A – flowering branchlet; B – fruiting inflorescence. Scale bars: A = 10 mm; B = 2 mm. Drawn by Margaret Wilson from *M. Hislop* 3635 (A), *E.M. Sandiford* EMS 994 (B).

Distribution and habitat. Currently known only from a small area east of Albany, between Two Peoples Bay Nature Reserve and Cheyne Beach, and north to the settlement of Manypeaks. (Figure 2) Within its very restricted distribution the species occurs in a surprising variety of habitats. It has been collected from hilltops, where it occurs in and around dense heath in shallow soils over granite, but also low in the landscape close to creek lines and on winter damp flats, where it may be a prominent species in the understorey of Marri woodlands in gravelly loam soils. The species even appears as a component of the vegetation of the fore-dunes growing in white sand under *Agonis flexuosa* and *Spyridium globulosum*.

Phenology. The main flowering period is between August and October with mature fruit present at least from October to December.

Etymology. From the Latin *altissimus* (highest, very tall), in reference to the unusual height (2–3 m) commonly reached by this species. Other tall western members of *Leucopogon s. str*. that sometimes grow to *c*. 2 m are *L. australis*, *L. parviflorus* (Andrews) Lindl., *L. verticillatus* R.Br. and *L. obovatus* (Labill.) R.Br. The latter grows alongside *L. altissimus* at the type locality.

Conservation status. *Leucopogon altissimus* is locally common and a number of populations are conserved in the Two Peoples Bay and Mount Manypeaks Nature Reserves and the Waychinicup National Park. However, the species has a very restricted geographical range which could render it especially vulnerable to any future threatening processes, including predicted anthropogenic climate change leading to hotter and drier conditions in this part of the south coast. The susceptibility of the species to the fast spreading, rootrot pathogen *Phytophthora cinnamomi* Rands. has also not been established, but many epacrids are known to be vulnerable (Keighery 1996).

Leucopogon altissimus is recently listed as Priority Three under DEC Conservation Codes for Western Australian Flora.

Affinities. Older collections of this species at PERTH had been assigned either to *L. australis* or *L. parviflorus.* Although the three species share a similar leaf morphology, fertile specimens of *L. altissimus* have characteristically deflexed, glabrous inflorescence axes, a character which separates it from all other western members of *Leucopogon s. str.* with the exception of *L. alternifolius*. The latter often has spreading or deflexed, as well as erect inflorescences, but is a low sprawling shrub with ovate, more or less stem-clasping leaves.

Notes. Other members of Group A that have been observed growing sympatrically with *Leucopogon altissimus* are *L. parviflorus*, *L. obovatus* and *L. verticillatus.*

Leucopogon australis R.Br., *Prod. Fl. Nov. Holl.* 541 (1810). *Styphelia australis* (R.Br.) F.Muell., *Fragm*. 6: 43 (1867). *Type*: King George Sound [Western Australia], 11 December 1801–5 January 1802, *R. Brown s.n.* (*lecto*, here designated: BM 000929077!; *isolecto*: BM 000929078!). *Paralecto*: Port Dalrymple (Georgetown) [Tasmania], 5 January 1804, *R. Brown s.n.* (BM 000929076!).

Leucopogon drummondii DC., *Prod.* 7(2): 745 (1839). *Type*: 'in Nova-Hollandia ad Swan-river cum plurib. aliis stirpibus rarissimis legit cl. Drummond!...(v.s.a. cl. inv.)', *J. Drummond s.n.* (*holo*: G, microfiche seen; *?iso*: K 000348325, K 000348326, scanned images seen).

Leucopogon paniculatus Sond. in Lehm., *Pl. Preiss*. 1(2): 306 (1845). *Type*: 'in turfoso-humidis inter fructices densos ad marginem lacus planitiei haud longe ab oppidulo Albany, (Plantagenet), 11 Oct. 1840', *L. Preiss* 374 (*lecto*, here designated: MEL 655770!).

Erect, robust *shrubs* to *c.* 2 m high and 1.8 m wide, but usually smaller, with fire tolerant rootstock. Young *branchlets* pale brown or straw-coloured, glabrous, the bark on older stems ± fissured, pale grey over reddish-brown. *Leaves* spirally arranged, antrorse, usually steeply so, narrowly ovate or narrowly elliptic, 22–75 mm long, 2.8–9.5 mm wide; apex acute or subacute; base cuneate; petiole usually well defined, pale to medium brown, 0.6–1.5 mm long, glabrous throughout or with a few hairs on the adaxial surface; lamina 0.1–0.25 mm thick, usually ± convex adaxially with slightly recurved margins, less often more prominently recurved or flat; surfaces discolorous, adaxial surface not shiny, glabrous, with 3–5 rather conspicuous, slightly sunken veins evident, abaxial surface paler, glabrous or with a sparse indumentum of short appressed hairs, striate, with 5–7 slightly raised primary veins, the midrib not differentiated; margins usually distinctly thickened and glabrous throughout, very occasionally with a few short, antrorse hairs about the apex. *Inflorescence* erect, terminal and upper-axillary; axis 8–34 mm long, with 8–28 flowers and terminating in a bud-like rudiment; indumentum of moderately dense to dense patent hairs, 0.08–0.2 mm long, the flowers erect and sessile. *Fertile bracts* ovate or broadly ovate, 0.7–1 mm long, 0.7–0.8 mm wide, obtuse; abaxial surface with moderately conspicuous venation, glabrous; adaxial surface glabrous; margins ciliolate. *Bracteoles* ovate or broadly ovate, 0.9–1.5 mm long, 0.9–1.3 mm wide, obtuse or subacute, sharply keeled; abaxial surface glabrous or with a few hairs along the keel, pale yellowish cream apart from the greenish keel; adaxial surface glabrous; margins densely ciliolate. *Sepals* ovate, 1.2–1.9 mm long, 0.9–1.5 mm wide, obtuse; abaxial surface glabrous or very occasionally with a few hairs towards the base, the central portion greenish or yellowish green, the rest of the surface pale yellowish cream becoming ± scarious towards the margins, the venation obscure to moderately conspicuous, pale; adaxial surface glabrous; margins densely ciliolate with hairs to *c.* 0.15 mm. *Corolla tube* white, broadly campanulate, about as long as or a little longer than sepals (by up to 0.4 mm), 1.0–1.5 mm long, 1.6–2.0 mm wide, glabrous externally and internally. *Corolla lobes* white, much longer than the tube (ratio = 1.3–2.1: 1), spreading from base and recurved, 2.3–2.7 mm long, 0.9–1.3 mm wide at base, glabrous externally, densely bearded internally, indumentum white, 0.5–0.6 mm long near apex, the glabrous tip to 0.2 mm long. *Anthers* usually partially exserted from the tube (by 3/4 to 7/8 of length), occasionally fully exserted, 1.3–2 mm long, slightly to prominently recurved at apex; sterile tips moderately conspicuous, 0.3–0.5 mm long; *filaments* terete, attached 2/3 to 3/4 above anther base, (0.7–)1–1.3 mm long, adnate to tube just below sinus. *Ovary* globose or depressed-globose, 0.5–0.7 mm long, 0.5–0.8 mm wide, glabrous, (4)5(6) -locular; *style* 0.5–0.8 mm long, either rather abruptly differentiated from ovary apex with parallel sides for most of length or tapering from ovary apex to a point *c.* half way up style and cylindrical above (*c.* 0.3 mm wide at base), included within corolla tube; *stigma* slightly to distinctly expanded; *nectary* annular 0.3–0.5 mm long, shallowly lobed for up to 1/4 of length or ± entire, glabrous. *Fruit* depressed-globose, with smoothly rounded shoulders, quite prominently ribbed in immature fruit, glabrous, 1.8–2.2 mm long, 2.5–3.3 mm wide, much longer than calyx, the surface with prominent transverse and longitudinal ridges; style persistent. (Figure 4)

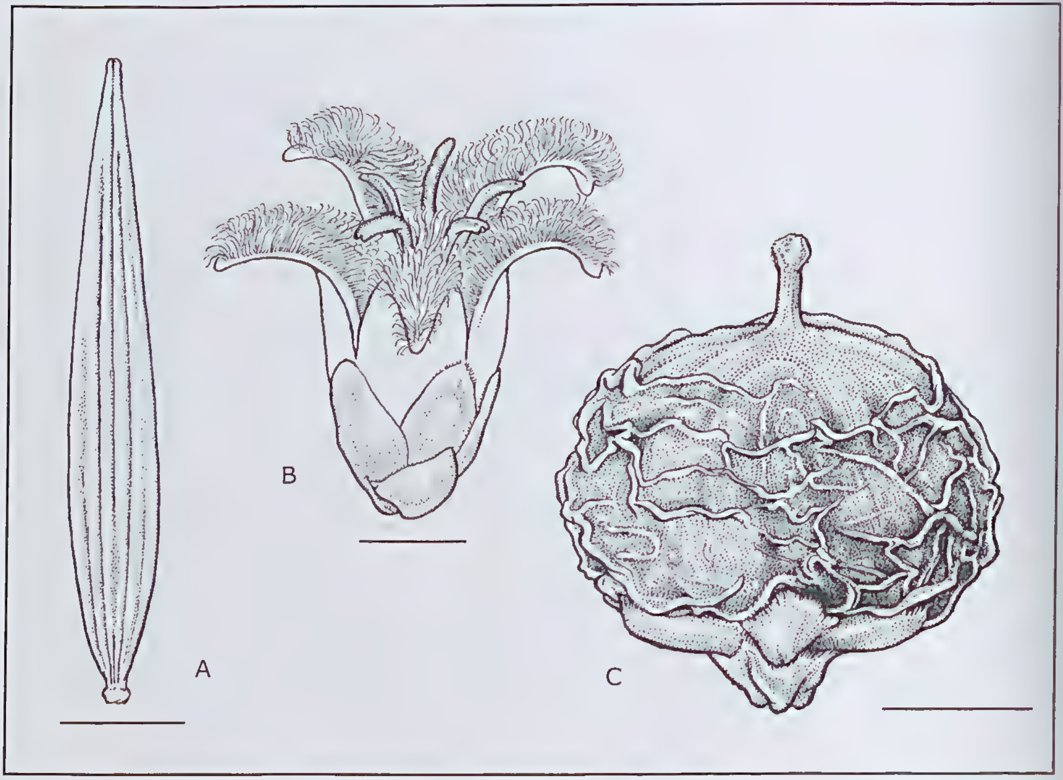

Figure 4. *Leucopogon australis*. A – leaf, adaxial surface; B – flower; C – fruit. Scale bars: A = 5 mm; B, C = 1 mm. Drawn by Margaret Wilson from *R.J. Cranfield & B.G. Ward* 913 (A, B), *C. Godden, D. Bright & T. Annels* SC 76.13 (C).

Other specimens examined. WESTERN AUSTRALIA: swampy ground Guildford, 5 Sep. 1907, *C. Andrews s.n.* (PERTH); Palings Rd, W of Manjimup, 21 Sep. 1988, *A.R. Annels* 367 (PERTH); N side of Apex Drive at start of Memorial Tree Drive [Albany], 5 Nov. 2004, *K. Baker* 166 (PERTH); Denmark Rd, just E of Marbellup Rd [W of Albany], 23 Oct. 1997, *E.A. Brown* 97/402, *P.G. Wilson & N. Lam* (CHR, NSW, NY, PERTH, UNSW); Ambergate Reserve, Busselton, 3 Aug. 1994, *D. Cooper* 4 (PERTH); 5.4 km SW from intersection between Trigwell Bridge Rd and McAlinden Rd, [SW of Collie], 30 Oct. 1997, *R.J. Cranfield* 11571 (PERTH); Sandy Rd, off Access Rd, 3 km E of Quinninup, 12 Sep. 1999, *R.J. Cranfield* 14023 (CANB, PERTH); Plot FC41, 100 m off Keene Rd on unnamed logging track, Barrabup Forest Block, 6 Sep. 2005, *R.J. Cranfield & B.G. Ward* FC 913 (PERTH); Bowelling–Duranillin Rd, W side of railway line and Wunnenberg Rd junction, 3 km SE of Bowelling, 5 Sep. 1994, *V. Crowley* DKN 549 (PERTH); Thompson 'Highway'[S of Lake Muir], 22 Nov. 1977, *H. Demarz* D6644 (PERTH); 300 m S down Della Rd from junction with Smiles Rd [SE of Margaret River], 12 Dec. 1996, *C. Godden, D. Bright & T. Annels* SC 76.13 (PERTH); Isle Rd 0.25 km S of South West Highway, [W of Walpole], 21 Oct. 1996, *M.S. Graham* MSG 626 (PERTH); close to Sues Bridge campsite, on Blackwood River, W of Nannup, 26 Nov. 2006, *M. Hislop* 3678 (PERTH, CANB, NSW); Christmas Tree Well, Brookton Highway, Beverley, 26 Sep. 2005, *F. Hort & J. Hort* 2627 (PERTH); Boonanarring Brook, 20 km NNE of Gingin, 1 Oct. 1988, *G.J. Keighery* 10285 (PERTH); Dingo Beach, West Cape Howe, 20 km W of Albany, 27 Nov. 1986, *G.J. Keighery* 11681 (PERTH); Modong Nature Reserve, Jandakot, 1 Oct. 1993, *G.J. Keighery* 12787 (PERTH); C. Milton property, 3 km S of Mount Barker, 25 Oct. 1977, *K.F. Kenneally* 6480 (PERTH); Long Swamp area, 2.6 km W from S end of Scott River Rd, 24 Aug. 1986, *J.M. Powell* 2631 (HO, K, NSW, PERTH). VICTORIA: Curdies River, 1890, *F. Hancock s.n.* (MEL 2121147); Foster,Gippsland Highlands, 1882, *Howitt [A.W.]*150 (MEL 2117948); Cape Otway Range, Nov. 1886, *Rob Lucas s.n.* (MEL 2121154); Heaths between Curdies River and the Gillibrand [Gellibrand], Mar 1874, *[F. Mueller] s.n.* (MEL 2117947); Wilsons Promontory, *Musgrari s.n.* (MEL 2117997). TASMANIA: Georgetown, *S. Hannaford* 861 (MEL 2121165).

Distribution and habitat. Leucopogon australis occurs in the south-west of Western Australia, southern Victoria and northern Tasmania. In Western Australia it is widely distributed and locally common in the wetter parts of the South-West, always within *c.* 100 km of the coast, from Gingin *c.* 100 km N of Perth, to the Augusta area and along the south coast to Albany (Figure 5). In the north of its range it is restricted to creek lines and swamps, but in the wettest parts of the lower south-west it also occurs higher in the landscape, as a component of the forest understorey.

Affinities. See notes under *Leucopogon interstans.*

Notes. The description above is based on Western Australian material only. The few eastern collections examined differed in having rather smaller floral parts (towards the lower end, and sometimes below the size range encountered in the western material) and a sparse, appressed indumentum on the adaxial sepal surface. The taxonomic significance, if any, of these differences requires the examination of a much larger specimen sample than was available to the author. However given the wide disjunction between the eastern and western populations, some morphological differences are to be expected.

Leucopogon interruptus R.Br., *Prod. Fl. Nov. Holl.* 541 (1810). *Styphelia interrupta* (R.Br.) Spreng., *Syst. Veg.* 1 (1824). *Type*: Goose Island [Recherche Archipelago, Western Australia], January 1802, *R. Brown s.n.* (*lecto*, here designated: BM 000929089!; *isolecto*: BM 000929090!).

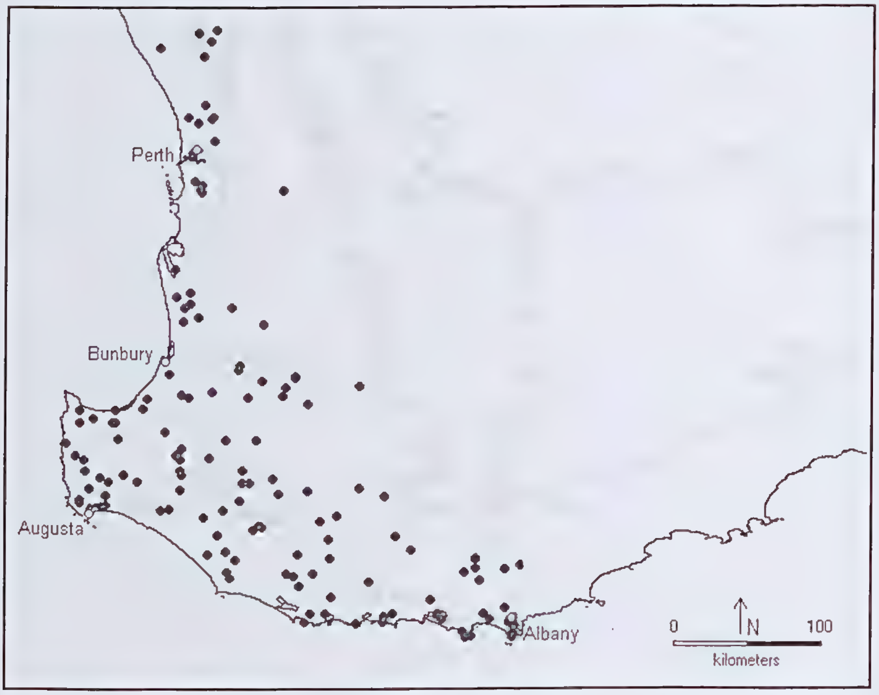

Figure 5. Distribution of *Leucopogon australis* (●) in south-west Western Australia. *Interim Biogeographic Regionisation Version 6.1* (Department of the Environment, Water, Heritage and the Arts 2008) boundaries are indicated in grey.

Leucopogon interstans Hislop, *sp. nov.*

Leucopogi australi affinis sed marginibus folii scabris, sepalis magis acutis et fructo ellipsoideo vel globoso differt.

Typus: Perillup Community Hall area, Muir Highway [SE of Rocky Gully], Western Australia, 24 July 1982, *J.M. Powell* 1958 (*holo*: PERTH 01841858; *iso*: CANB, K, L, MEL, NSW).

Leucopogon richei (Labill.) R.Br. var. *acutifolius* Benth., *Fl. Austral.* 4: 186 (1869). *Type*: 'Stirling Range, F. Mueller'. (*holo*: K 000348269, scanned image seen).

Leucopogon australis R.Br. subsp. *acutifolius* (Benth.) J.M.Powell ms., in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 238 (2000), *nom. inval.*

Erect, *shrubs* to *c.* 1.5 m high, but usually less than 1 m, and 1.2 m wide across, with fire-tolerant rootstock. Young *branchlets* light brown or reddish brown, with a sparse or less often moderately dense indumentum of very short patent hairs, < 0.1 mm long (sometimes hairs confined to nodal areas), at length glabrescent; bark on older stems pale grey over reddish brown and often rather stringy. *Leaves* spirally arranged, antrorse, usually steeply so, narrowly elliptic, or less often narrowly ovate or narrowly obovate, 13–53 mm long, (1–)1.3–5 mm wide; apex acute or subacute; base attenuate or cuneate; petiole varying from indistinct to moderately well defined, light brown or yellowish brown.

similar in texture to the lamina, 0.7–1.3 mm long, shortly hairy on adaxial surface and margins, glabrous abaxially; lamina 0.15–0.25 mm thick, slightly concave, flat or slightly convex adaxially; surfaces somewhat discolorous, adaxial surface not or barely shiny, glabrous, except sometimes immediately above the petiole, with 3–5 rather indistinct, slightly sunken veins, abaxial surface paler, glabrous, ± striate, with 5–7 usually slightly raised primary veins, the midrib not differentiated; margins scabrous with stiff, antrorse hairs to 0.2 mm long. *Inflorescence* erect, terminal and upper-axillary; axis 7–23 mm long, with 5–14 flowers, terminating in a bud-like rudiment; indumentum of moderately dense to dense, patent or slightly retrorse, straight hairs, 0.08–0.15 mm long, flowers erect and sessile. *Fertile bracts* ovate or broadly ovate, 0.7–1 mm long, 0.7–0.8 mm wide, obtuse; abaxial surface with conspicuous venation, shortly hairy towards the base and sometimes also close to the apex; abaxial surface shortly hairy; margins ciliolate. *Bracteoles* ovate, 0.9–1.5 mm long, 0.7–1 mm wide, acute or subacute, keeled; abaxial surface with short patent hairs along the entire length of the keel, or restricted to apical and basal portions only, very sparsely hairy or glabrous elsewhere, reddish-purple, becoming scarious towards margins; adaxial surface appressed-hairy; margins densely ciliolate. *Sepals* ovate or narrowly ovate, (1.2–)1.4–2.2 mm long, 0.7–1.2 mm wide, subacute or acute; abaxial surface glabrous throughout or with a few hairs towards apex, the venation conspicuous, pale, alternating with broader, reddish purple interveinal bands, becoming scarious towards margin; adaxial surface appressed-hairy in central portion; the margins densely ciliolate with hairs to *c.* 0.1 mm long. *Corolla tube* white, broadly campanulate, usually about as long as to distinctly shorter than sepals, 1–1.6 mm long, 1.5–1.8 mm wide, glabrous externally and internally. *Corolla lobes* white, often partially tinged pink or sometimes pink throughout, longer than the tube (ratio = 1.1–2.1:1), widely spreading from base and recurved, 1.7–2.7 mm long, 0.8–1.0 mm wide at base, glabrous externally, densely bearded internally, indumentum white, 0.4–0.6 mm long near apex, the glabrous tip to 0.2 mm long. *Anthers* usually slightly exserted from the tube, less often partially exserted (by 7/8 or more of length), (0.7–)0.9–1.5 mm long, slightly or prominently recurved at apex; sterile tips usually rather conspicuous, 0.2–0.3 mm long; *filaments* terete, attached 1/2–3/4 above anther base, (0.5–)0.7–1.1 mm long, adnate to tube just below sinus. *Ovary* broadly ellipsoid to globose, 0.5–0.7 mm long, 0.5–0.7 mm wide, glabrous, (3-)4 or 5-locular; *style* 0.5–0.8 mm long, abruptly differentiated from ovary apex, cylindrical for most of length, included within corolla tube; *stigma* slightly to distinctly expanded; *nectary* annular, 0.2–0.4 mm long, usually lobed for 1/3–1/2(–3/4) of length, but occasionally entire, glabrous. *Fruit* rather variable in shape, ellipsoid, broadly ellipsoid, globose or occasionally slightly depressed-globose, with smoothly rounded shoulders, glabrous, 3–4.5 mm long, 2.6–3.2 mm wide, much longer than calyx, the surface with a prominently raised reticulum of transverse and longitudinal ridges; style persistent. (Figure 6)

Selected specimens examined. WESTERN AUSTRALIA: Gum Link Rd, 1.7 km W of Nornalup Rd, 20 Aug. 1990, *A.R. Annels ARA* 1210 (CANB, PERTH); Mt. Magog, Stirling Range National Park, 18 Oct. 1994, *S. Barrett* 50 (PERTH); Ellen Track, near junction with South Bluff track, [Stirling Range National Park], 8 Feb. 2006, *S. Barrett* 1431 (CANB, PERTH); Porongurups, Aug. 1958, *A. Chapman s.n.* (PERTH 05904331); Mt Trio, vicinity of carpark and 100 m up trail, Stirling Range National Park, 30 Oct. 1986, *R.S. Cowan* A-502 (CANB, K, NSW, PERTH); Plot FC41, 100 m off Keene Rd on unnamed logging track, Barrabup Forest Block, 6 Sep. 2005, *R.J. Cranfield & B.G. Ward* FC 913A (PERTH); 4.3 km N along Cup Rd from Muir Highway [NW of Lake Muir], 19 Feb. 1998, *R. Davis* 6053 (PERTH); Elwin Rd sandpit, Bridgetown, 5 July 1996, *J. Dewing* 778 (PERTH); between Napier and Mount Manypeaks, 5 Oct. 1967, *A.R. Fairall* 2254 (PERTH); Northcliffe Forest Park, 18 Aug. 1991, *L. Graham* 767 (PERTH); corner of Crouch Rd & Great North Rd, Whicher Range, 20 Aug. 2004, *M. Hislop* 3296 (PERTH); Pitcher Plant Rd, 100 m S of Beardmore Rd, N of Walpole, 29 Dec. 2005, *M. Hislop* 3564 (NSW, PERTH); close to Sues Bridge Campsite, on Blackwood River, W of Nannup, 26 Nov. 2006, *M. Hislop* 3679 (CANB, PERTH); Kent River Siding, Walpole to Denmark,

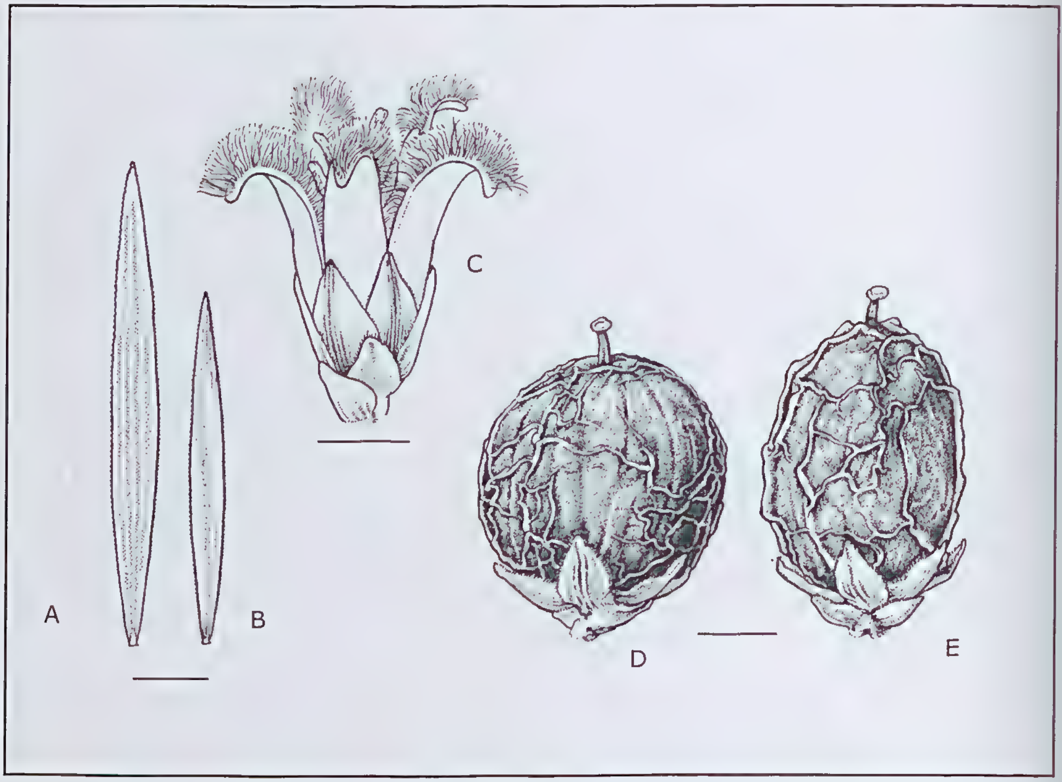

Figure 6. *Leucopogon interstans*. A, B – leaves, adaxial surface; C – flower; D, E – fruit. Scale bars: A, B = 5 mm; C, D, E = 1 mm. Drawn by MargaretWilson from *R.J. Cranfield & B.G. Ward* 913A (A, C), *A. Strid* 20552 (B), *M. Hislop* 3679 (D), *M. Hislop* 3564 (E).

11 Aug. 1986, *G.J. Keighery* 8273 (PERTH); Windy Harbour Rd, 9 Sep. 1971, *S. Paust* 312 (PERTH); Kalgan River, 23 Oct. 1992, *L.J. Pen* LJP 202 (PERTH); *c*. 9 km NNW of Denmark on Mt Lindesay Rd, 1 km W of Denmark River, 16 Aug. 1979, *J.M. Powell* 1193 (CANB, HO, K, L, NSW, PERTH); track to Marmabup Rock across Devils Slide, Porongurup National Park, 18 Aug. 1979, *J.M. Powell* 1210 (CANB, K, L, NSW, PERTH); slope N of stream on track to Bluff Knoll summit, Stirling Range National Park, 19 Aug. 1979, *J.M. Powell* 1235 (K, L, NSW, PERTH); Yungermere track, *c*. 400 m E of Chester Pass Rd, Stirling Range National Park, 30 Aug. 1986, *J.M. Powell* 2733 (NSW, PERTH); Site 130, S of Beardmore Rd, E of South Western highway, [N of Walpole], 25 Aug. 1997, *K.A. Redwood* 504 (PERTH); Scott River National Park, 6 Sep. 1990, *C.J. Robinson* 31 (PERTH); Stirling Range National Park, lower slopes SE of Toolbrunup Peak, 26 Sep. 1982, *A. Strid* 20552 (PERTH); Walpole–Nornalup National Park, Twenty Eight Mile Rd at N boundary of park, 12 Aug. 1992, *J.R. Wheeler* 3143 (PERTH); just N of Stirling Range National Park, *c*. 25 km E of Cranbrook, 18 Sep. 1964, *P. Wilson* 3322 (AD, PERTH); on the summit of Bluff Knoll, Stirling Range National Park, 31 Oct. 1994, *A. Worz* 04.10.31.05 (PERTH).

Distribution and habitat. Leucopogon interstans is widespread in the south-west corner of Western Australia from the Scott River area near Augusta, eastwards to Albany, and as far north as Bridgetown and the Stirling Range (Figure 7). Across most of its range, *L. interstans* is a plant of woodland and forest, where it grows in loam or sandy loam soils. In the Stirling Range, however, as well as occurring in woodlands on the lower slopes, it is also present as a component of heathland communities on the upper slopes of the mountains.

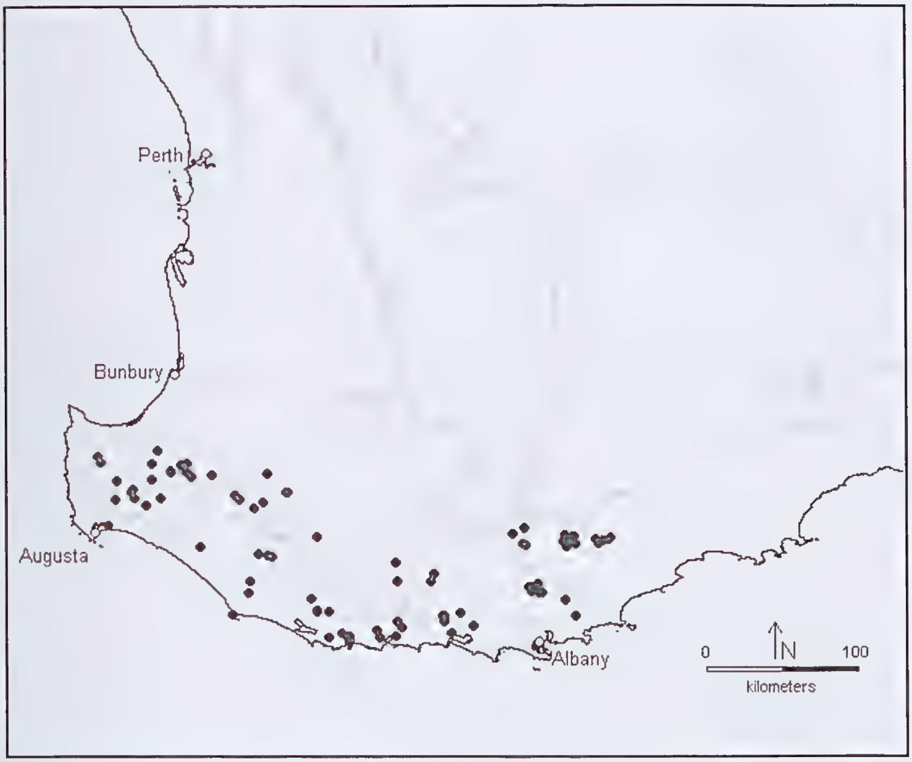

Figure 7. Distribution of *Leucopogon interstans* (●) in south-west Western Australia. *Interim Biogeographic Regionisation Version 6.1* (Department of the Environment, Water, Heritage and the Arts 2008) boundaries are indicated in grey.

Phenology. Peak flowering occurs from August to October and mature fruit have been collected between November and February.

Eymology. The specific epithet is from the Latin *interstans* (standing in between), a reference to the vegetative morphology of the new species which is somewhat intermediate between *L. australis* and *L. capitellatus* DC., the two species with which it has often been confused.

Conservation status. *Leucopogon interstans* is common across its range and is conserved in a number of National Parks and Nature Reserves.

Affinities. *Leucopogon interstans* is morphologically similar to *L. australis* and *L. capitellatus*. From the former, the new species differs in having scabrous rather than glabrous leaf margins, more acute sepals which are always tinged reddish purple when in flower (although fading in fruit), and ellipsoid or globose (very occasionally slightly depressed-globose), rather than strongly depressed-globose fruit.

Smaller-leaved plants may be mistaken for *L. capitellatus*. The two species share scabrous leaf margins, although the marginal hairs are longer in the latter and the upper leaf surface is hairy (glabrous in *L. interstans*, apart sometimes for a few hairs at the very base). Additionally, the branchlet indumentum of *L. capitellatus* is much longer, the sepals are manifestly obtuse and the inflorescence is shorter and denser.

The three species are sympatric across large areas of the southern forest, and although specimen-based evidence is limited, it seems likely that they would regularly share the same habitat. *Leucopogon interstans* and *L. australis* are certainly known to grow side by side on and around the Whicher Range, for example, as confirmed by the following collections–*R.J. Cranfield & B.G. Ward* FC 913A and 913, and *M. Hislop* 3679 and 3678 (in both cases *L. interstans* and *L. australis* respectively). In the Porongurup Range *L. capitellatus* and *L. interstans* also grow along side each other, as demonstrated by the specimen pair *A. Chapman s.n.* (PERTH 05904331) and *A. Chapman s.n.* (PERTH 07512279) (*L. interstans* and *L. capitellatus* respectively).

Notes. *Leucopogon interstans* is a variable species in regard to leaf size, inflorescence length, fruit shape and in some floral details. The Stirling Range populations represent the most distinctive form of the species, especially in terms of their foliar morphology. These usually have leaves that are concave adaxially, less often flat, and only very occasionally convex. By contrast forest populations of the species have convex leaves as the norm with the occurrence of concave leaves apparently uncommon. In addition, leaves of plants from the Stirling Range are generally smaller and have more acuminate apices (especially from plants collected in the high peaks). Floral measurements are also usually at the lower end of those recorded for the species as a whole with sepal length as low as 1.2 mm long (compared to a minimum of 1.4 mm elsewhere), anther length down to 0.7(–0.9) mm and filaments to 0.5(–0.7) mm. Additionally, the nectary is often more deeply lobed and the flowers sometimes have 3-locular as well as the usual 4 or 5-locular ovaries.

Although such differences appear to indicate a level of divergence in these Stirling Range populations, no morphological characters by which to consistently separate them from the forest populations were identified during this study. In the case of leaf curvature, the strongest of the foliar characters, two specimens from the Stirling Range housed at PERTH (i.e. *J.M. Powell* 2733 and *F.W. Went* 155) have leaves either all convex in the latter case, or a combination of convex and concave in the former. Conversely in the southern forests, where convex leaves are the norm, occasional examples can be found of specimens with predominantly concave leaves (e.g. *K.A. Redwood* 345, from north-east of Denmark and *R. Davis* 7748, from west of Nannup). Additionally, collections from the Porongurup Range, to the south of the Stirling Range, may have either concave or convex leaves. Although the Stirling Range populations tend to have somewhat smaller flowers, there are no clear disjunctions in floral morphology, and the variation in fruit shape described above occurs within the forest populations. Only ellipsoid drupes have been observed on collections from the Stirling Range.

Bentham's concept of *Leucopogon richei* var. *acutifolius* was presumably restricted to the Stirling Range variant as Mueller's holotype is the only collection cited.

Leucopogon polystachyus R.Br., *Prod. Fl. Nov. Holl.* 542 (1810). *Styphelia polystachyus* (R.Br.) Spreng., *Syst. Veg.* 1 (1824). *Type*: King George Sound, between Princess Royal Harbour and Cape Howe [Western Australia], December 1801, *R. Brown s.n.* (*lecto*, here designated: BM 000929101!; *isolecto*: BM 000929102!, MEL 78545, scanned image seen).

Leucopogon polystachyus var. *serratifolius* Sond. [published as β *serratifolius*] in C. Lehmann, *Pl. Preiss*. 1: 308 (1845). *Type*: 'In arenoso-turfosis humidis inter fructices densos prope villam beat Rich. Spencer, Plantagenet', 23 September 1840, *L. Preiss* 364 (*lecto,* here designated: MEL 78550; *isolecto*: MEL 78549, scanned images seen).

Leucopogon polystachyus var. *monostachys* Sond. [published as γ monostachys] in C. Lehmann, *Pl. Preiss*. 1: 308 (1845). *Type*: 'Habitat cum priore', 23 September 1840, *L. Preiss* 364 ex parte (*holo*: MEL 78551, scanned image seen).

Other specimens examined. WESTERN AUSTRALIA: Kordabup Rd, Denmark, 12 Sep. 1991, *A.R. Annels* 1654 (PERTH); Deeside Coast Rd, Re/JL 81, Manjimup, 17 Oct. 1983, *A.R. Annels* 1705 (PERTH); *c*. 400 m along Ficifolia Rd from junction with Nut Rd, N side of road, Walpole–Nornalup National Park, 10 Oct. 2003, *D.M. Crayn* 719, *K.A. Kron & A.J. Perkins* (NSW, PERTH, WFU); roadside above Cosy Corner Beach, off Lower Denmark Rd, Albany, 13 Sep. 1987, *E.J. Croxford* 5656 (PERTH); corner of Steve Rd and unnamed track, *c*. 2.4 km E of Chesapeake Rd [S of Northcliffe], 29 Sep. 1996, *M.S. Graham, M.D. Carter* MSG 602 (CANB, PERTH); Boronia Rd, 1.5 km E of Collis Rd [NE of Walpole], 6 Oct. 1997, *M.S. Graham* MSG 863 (PERTH); Denbarker state forest, Nutcracker Rd, 2.5 km W of Denmark–Mount Barker Rd, 4 Sep. 1994, *B.G. Hammersley* 1128 (NSW, PERTH); Grasmere, 12 km W of Albany, 7 Dec. 1986, *G.J. Keighery* 9024 (CANB, PERTH); lower slopes of Mt Lindesay, 16 Aug. 1979, *J.M. Powell* 1205 (BRI, CANB, MEL, NSW, NY, PERTH); roadside towards Elleker, W of Albany, 20 Aug. 1993, *C.J. Robinson* 1121 (PERTH).

Notes. The morphological basis for the recognition of Sonder's (1845) two infraspecific taxa is slight. Bentham (1868) ignored them completely in his treatment of the species, despite including *Preiss* 364 (the type number for both of these varieties) in his list of cited specimens. Sonder (1845) separated var. *serratifolius* from the typical form of *L. polystachyus* on the basis of differences in leaf morphology, with the former having more spreading leaves with serrulate (rather than glabrous) leaf margins and a more acute apex. Variety *monostachys* was said to differ primarily in its single-spiked inflorescence.

An examination of collections of *L. polystachyus* held at PERTH does not support the recognition of either of these taxa. The leaf orientation of *L. polystachyus* is generally steeply antrorse, although occasionally the lower leaves may be more or less spreading. The shape is usually narrowly or very narrowly ovate, less often narrowly elliptic, and the apex is a blunt callus which varies very slightly in width. As with many species of *Leucopogon s. str*., details of the indumentum on vegetative parts of the plant vary considerably. Most collections have leaves which are more or less ciliate when young. Generally these hairs are soon lost as the leaves mature, leaving only the thickened bases which produce the more or less serrulate margins observed by Sonder (1845). Less often these hairs persist at maturity, or are entirely absent, as is the case with the type collection of *L. polystachyus*. Those specimens that lack any semblance of marginal hairs, even on the youngest leaves, have all been collected towards the eastern end of the species' range in the Albany–Denmark area. Differences in leaf and branchlet indumentum within this species, however, do not appear to correlate with any floral or fruiting characters.

Although the single-spiked conflorescence used by Sonder as the basis for his recognition of var. *monostachys* is unusual, this characteristic is observable sometimes on the lower branchlets of specimens with otherwise typical, multispicate conflorescences (e.g. *E.J. Croxford* 5656) and clearly has no taxonomic significance.

Leucopogon wheelerae Hislop, *sp. nov.*

Leucopogi alternifolio affinis sed floribus et fructis grandioribus, lobis corollae magis dense pilosis differt.

Typus: north-west of Augusta [precise locality withheld for conservation reasons], Western Australia, 10 October 1997, *E.A. Brown* 97/262 *& G. Taaffe* (*holo*: PERTH 05073790; *iso*: CANB, NSW, NY, UNSW).

Sprawling *shrubs* to 80 cm high and 80 cm wide, single-stemmed at ground level, with a fire-sensitive rootstock. Young *branchlets* very slender, pale brown or reddish-purple, glabrous; bark on older branchlets grey, ± fissured. *Leaves* spirally arranged, antrorse, ovate or broadly ovate, 3.5–7.9 mm long, 2.6–7.2 mm wide; apex acute or subacute, recurved or straight; base cordate, often deeply so and ± stem clasping; petiole indistinct, glabrous, pale brown or reddish-brown, to *c.* 0.2 mm long; lamina 0.1–0.3 mm thick, usually slightly recurved along longitudinal axis, concave, often deeply so with the adaxial surface ± folded longitudinally, but usually becoming slightly recurved towards the margins; surfaces discolorous, glabrous, adaxial surface slightly shiny, venation not or barely evident, except sometimes close to the base, abaxial surface paler with 7–9(–11) primary veins and significant development of secondary veins, the midrib not differentiated; the margins pale, slightly thickened, entire or crenulate, glabrous. *Inflorescence* erect or spreading, terminal and axillary, the latter extending down the flowering branchlet for many nodes; axis glabrous or occasionally with a very sparse indumentum of short patent hairs, 4–7 mm long, with 4–12 flowers, terminating in a bud-like rudiment or acute point, flowers erect and sessile. *Fertile bracts* broadly ovate or ovate, 0.9–1.3 mm long, 0.9–1.2 mm wide, obtuse to subacute; abaxial surface with moderately conspicuous venation, glabrous or minutely papillose; adaxial surface appressed-hairy; margins minutely ciliolate. *Bracteoles* broadly ovate or ovate, 0.7–1 mm long, 0.7–0.9 mm wide, subacute, rather obscurely keeled; abaxial surface usually minutely papillose about the keel, glabrous elsewhere, the central portion greenish, becoming paler and scarious towards the margins, or frequently the whole surface suffused reddish purple, the venation usually moderately conspicuous; adaxial surface appressed-hairy; the margins minutely ciliolate. *Sepals* ovate or narrowly ovate, 1.5–2.1 mm long, 0.6–1 mm wide, subacute; abaxial surface minutely papillose at least towards apex, the central portion greenish often suffused reddish-purple, with the pale venation rather conspicuous, either becoming scarious towards the margins or more often the whole surface suffused reddish purple; adaxial surface appressed-hairy towards the apex; the margins minutely ciliolate with hairs < 0.05 mm long. *Corolla tube* white, broadly campanulate, about as long as, slightly longer than, or slightly shorter than the sepals, 1.3–1.8 mm long, 1.5–1.7 mm wide, glabrous externally, but with hairs extending onto the inner surface of the tube below the lobes for up to 0.5 mm. *Corolla lobes* white or pale pink, longer than tube (ratio = 1.1–1.4: 1), widely spreading from base and recurved, 1.7–2.1 mm long, 0.8–1 mm wide at base, glabrous externally, densely bearded internally, indumentum white, 0.3–0.5 mm long near apex, the glabrous tip 0.1–0.2 mm long. *Anthers* partially exserted from the tube (by *c.* 2/3 of length), 1.2–1.6 mm long, prominently recurved at apex; sterile tips rather conspicuous, 0.4–0.7 mm long; *filaments* terete, attached 1/2–2/3 above anther base, 0.4–0.5 mm long, adnate to tube just below sinus. *Ovary* globose or broadly ellipsoid, 0.5–0.6 mm long, 0.5–0.6 mm long, glabrous, 3(4)-locular; *style* 0.5–0.7 mm long, tapering from base to apex, minutely papillose; included within the corolla tube; *stigma* slightly to distinctly expanded; *nectary* annular, 0.2–0.3 mm long, lobed for up to 1/3 of length, glabrous. *Fruit* elliptic or asymmetrically elliptic in outline, compressed when 1 or 2 ovules develop, or trigonous, when all 3 develop, glabrous or minutely papillose towards the apex, 1.8–2.1 mm long, 1.1–1.5 mm wide, longer than the calyx, the surface with a raised reticulum; style persistent. (Figure 1 C–E)

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 10 Aug. 1995, *R.W. Hearn, R. Annear & A.R. Annels* ARA 5393 (PERTH); 8 Sep. 1965, *A.C. Beauglehole* 12571 (NSW, PERTH); 3 Feb. 1997, *E. Bennett & B. Evans* P 26.1 (PERTH); 24 Aug. 1986, *A.R. Chapman* 356 *& J.M. Powell* (NSW, PERTH); 9 Oct. 2000, *R.J. Cranfield* 15484 (CANB, NSW, PERTH); 19 Sep. 1995, *R. Davis* 146 (PERTH); 2 Oct. 1976, *A.S. George s.n.* (PERTH

1024442); 26 Nov. 2006, *M. Hislop* 3680 (CANB, PERTH); 8 Sep. 1971, *S. Paust* 254 (NSW, PERTH); 9 Nov. 1985, *J.M. Powell* 3072 (HO, NSW, PERTH); 25 Sep. 1990, *C.J. Robinson* 152 (PERTH).

Distribution and habitat. Occurs in the far south-west corner of Western Australia between the Hardy Inlet, near Augusta, and the Donnelly River (Figure 2). In this area the species is restricted to heath or woodland edge on seasonally wet flats.

Phenology. The main flowering period is from August to October. Mature fruit has been collected in November but is probably present as early as October through to the end of the year.

Etymology. The species epithet honours Judith R. Wheeler, botanist at the Western Australian Herbarium 1982–2002. Judy made a substantial contribution towards a better understanding of Western Australia's large and complex flora, both through the leading role that she played in the production of three regional floras, and as a taxonomist working on the genera *Hibbertia* and *Agonis* (and segregate genera). In her treatment of *Leucopogon* for the *Flora of the South West* (Wheeler *et al*. 2002), Wheeler first drew attention to some of the differences between the eastern and western populations of *Leucopogon alternifolius* that have been formally recognised here.

Conservation status. *Leucopogon wheelerae* is a locally common species occurring in a narrow east–west band, apparently less than 50 km long and probably nowhere more than 15–20 km wide. Populations are known to be conserved in the Scott River National Park. It probably also occurs at Gingilup Nature Reserve (unvouchered record), and may well be present at the western end of D'Entrecasteaux National Park, but this has yet to be demonstrated.

As noted above, when *L. alternifolius* was originally removed from the Priority List it was largely on the strength of the discovery of new populations of the segregate species recognised here as *L. wheelerae*. However, in common with two of the other species treated in this paper, *L. altissimus* and *L. alternifolius sens. str*., *L. wheelerae* is restricted to a small area in one of the wettest districts of southern Western Australia, and as such is likely to be particularly vulnerable to the warming and drying effects of predicted climate change.

Leucopogon wheelerae is recently listed as Priority Three under DEC Conservation Codes for Western Australian Flora.

Affinities. *Leucopogon wheelerae* is clearly closely related to the species with which it has hitherto been confused, *L. alternifolius*. The larger floral parts and fruit of the new species however, together with its campanulate corolla tube and more densely hairy corolla lobes will readily separate the two. The distinctive fruit character that the two species share is not seen elsewhere among the Western Australian members of *Leucopogon s. str*. A recent study of molecular sequence data (Quinn *et al*. 2003) however, supported Bentham's (1869) observation that the eastern Australian *Leucopogon amplexicaulis* R.Br. is likely to be a close relative.

Acknowledgements

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A new species of *Rorippa* (Brassicaceae) from southern Western Australia

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Abstract

Keighery, G.J. A new species of *Rorippa* (Brassicaceae) from southern Western Australia. *Nuytsia* 18(1): 79–82 (2008). The Western Australian populations of *Rorippa dictyosperma* (Hook.) L.A.S.Johnson are segregated as a new species, *R. cygnorum* Keighery *sp. nov.*

Introduction

This paper is one of a continuing series on the taxonomy of the native and naturalised Brassicaceae of Western Australia.

Rorippa Scop. (Brassicaceae) is closely related to *Cardamine* L., *Aradidopsis* Heyne and *Nasturtium* W.T.Aiton. The last genus is often included in a broadly defined *Rorippa*. In this sense *Rorippa* is a cosmopolitan genus of approximately 75 species and has four endemic and three introduced species in Australia (Johnson 1962; Hewson 1982). There are three species recorded for Western Australia, two native and one introduced. The sole native species of *Rorippa* currently recorded for southern Western Australia, *R. dictyosperma* (Hook.) L.A.S.Johnson, also occurs in New South Wales, Victoria and Tasmania (Hewson 1982). The type collection of *Rorippa dictyosperma* is from Tasmania, viz. *R.C. Gunn* 80, 401 (K, photo seen).

The Western Australian form of *Rorippa dictyosperma* differs from Eastern Australian populations in being an annual, with shorter, thicker pedicels (4–8 vs 10–20 mm), a much shorter style (2 vs. 4 mm) and much finer reticulation on the seed. Hewson (1982) and Johnson (1962 and in litt.) suggested that the Western Australian populations should be recognised as a separate taxon, but did not formalise this separation. These character differences warrant taxonomic recognition and the Western populations are described here as a new species, *R. cygnorum* Keighery.

Taxonomy

Rorippa cygnorum Keighery, *sp. nov.*

Rorippa dictyospermae affinis sed habitu annuo, stylo brevi vel brevissimo, pedicello crasso brevi, testa subtiliter reticulata differt.

Typus: Porongurup Range [precise locality withheld for conservation reasons], 3 December 1988, *G.J. Keighery* 10416 (*holo*: PERTH 4400208; *iso*: CANB, K).

Erect annual herb, 30–90 cm tall, rarely decumbent. *Leaves* petiolate; basal leaves pinnatisect, to 20 cm long, with large terminal lobe, the lateral segments few, ovate or oblong, entire or toothed, stem leaves reducing to lanceolate, entire, petiolate. *Sepals* 2.5–5 mm long, petals 5–10 mm long, white. *Stamens* 6, style 2 mm long. *Siliqua* straight or slightly curved, 25–60 mm long, 1–2 mm wide ascending; pedicel spreading to reflexed, 4–8 mm long; seeds in one row per loculus, not mucilagenous when wet, very finely reticulate, ovoid to oblong, 1–2 mm long. (Figure 1)

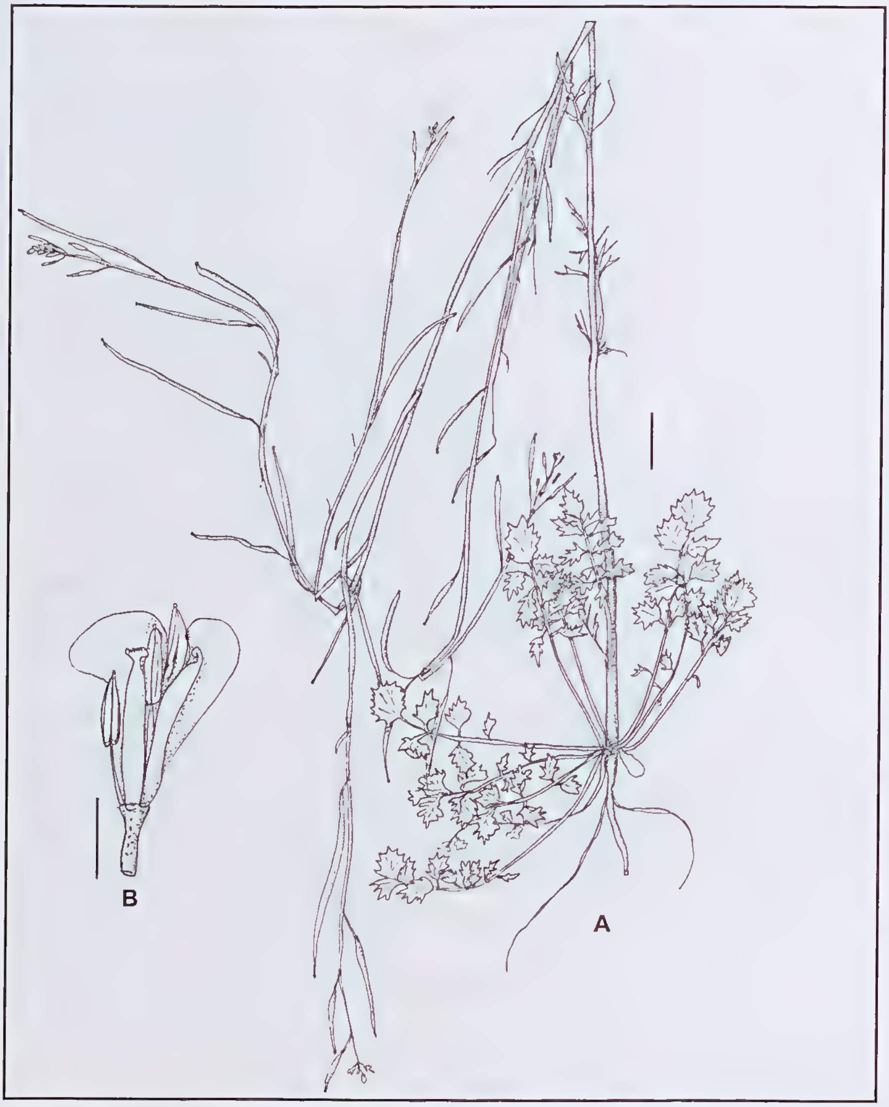

Figure 1. *Rorippa cygnorum* (both from *B. & G. Keighery* 1122). A – whole plant; B – flower with half floral parts removed to show anthers and style. Scale bars: A = 20 mm; B = 2 mm.

Selected specimens examined. WESTERN AUSTRALIA: [localities withheld] 29 Nov. 1990, *A.R. Annels* 1399 (PERTH); 30 Nov. 1994, *A.R. Annels & R.W. Hearn* 5066 (PERTH); [without locality], *s.dat., J. Drummond* 94 (MEL); 14 Jan. 1989, *G.J. Keighery* 11945 (PERTH); 1 Nov. 2007, *G. & B. Keighery* 1122 (PERTH); 26 Aug. 1997, *K.A. Redwood* 586 (PERTH); Oct. 1867, *F. von Mueller* (MEL 93091); *s. dat., P. Walcott s.n.* (MEL).

Distribution. Recorded in a series of disjunct populations from the Porongurup Range to north of Walpole in the Jarrah Forest and Warren biogeographic regions (Figure 2).

Habitat. Occurs on moss swards on granite rocks or along seepage lines below granites, the latter in the eastern part of the range (e.g. Porongurup Range), especially after summer fires. In eastern Australia, the related *Rorippa dictyosperma* occurs in forests and woodlands from the coast to subalpine areas (Entwisle 1996).

Flowering period. Flowers in late spring to early summer, from late November to January. Mature fruits and seeds are present from December to February.

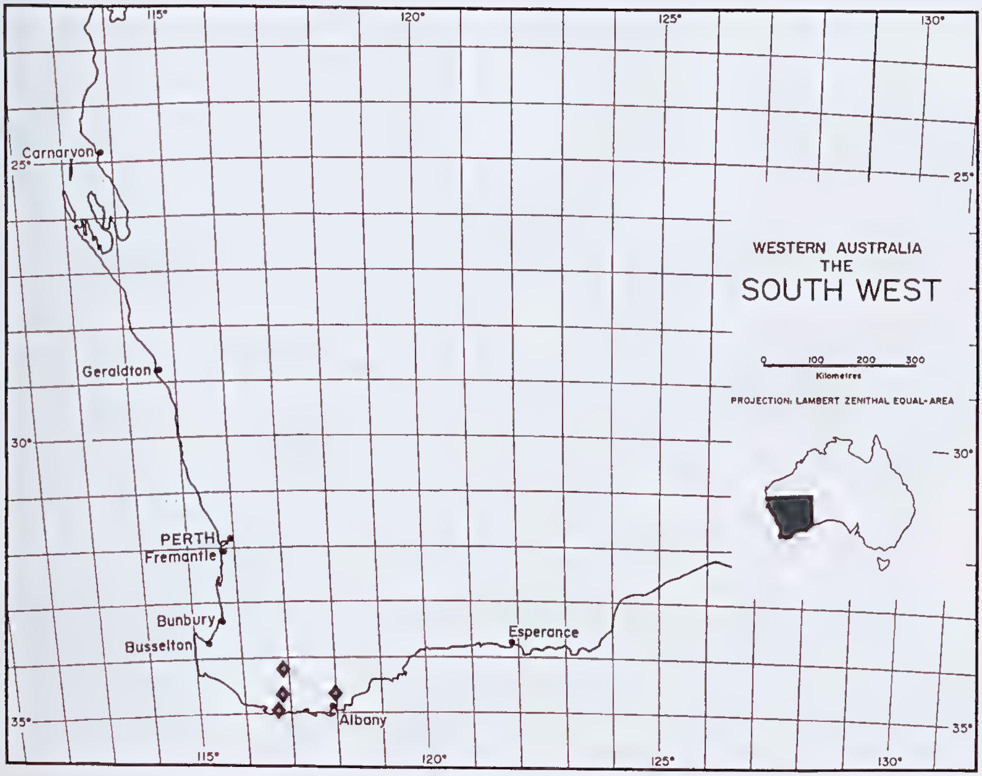

Figure 2. Distribution of *Rorippa cygnorum* in southern Western Australia.

Conservation status. Listed as Priority Two under Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora by Atkins (2008) under the name *R. dictyosperma*.

Etymology. From the Latin *cygnus* (swan), in reference to the original name for Perth, the Swan River Colony.

Notes. The common name for *Rorippa dictyosperma* in Eastern Australia is Forest Bitter Cress, the name Western Bitter Cress is suggested for this species.

Acknowledgements

The author was able to examine type material of *Rorippa dictyosperma*, and other collections at MEL with the assistance of the former Curator of Melbourne Herbarium, Jim Ross. Thanks are also due to the other bodies (Environment Australia (now Department of Environment and Herritage) and the Australian Heritage Commission) who funded the many biological surveys noted herein.

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Elucidation of *Olearia* species related to *O. paucidentata* (Asteraceae: Astereae)

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Abstract

Lander, N.S. Elucidation of *Olearia* species related to *O. paucidentata* (Astereaceae: Astereae). *Nuytsia* 18(1): 83–95 (2008). A group of south-west Western Australian endemic species related to *Olearia paucidentata* (Steetz) F.Muell. ex Benth. are distinguished, and an identification key and comprehensive descriptions of each are presented. *O. paucidentata* is lectotypified. *Eurybia lehmanniana* Steetz is re-instated at specific rank as *Olearia lehmanniana* (Steetz) Lander. Maps and notes on typification, distributions, etc. of each species are provided.

Introduction

Prior to the preparation of an account of *Olearia* Moench (Asteraceae) in the ongoing *Flora of Australia* series it is necessary to clarify the limits of a number of Western Australian species described by Joachim Steetz (1845) which are easily confused and have been difficult to distinguish.

My taxonomic studies of species currently recognized as *Olearia* are ongoing and it is highly likely that generic and infrageneric concepts will change as a result of molecular-phylogenetic studies (Cross *et al.* 2002). In the meantime, the group of species considered here is referred to *Olearia* sect. *Merismotriche* Archer ex Benth. (1867).

In general, the descriptive terminology used in this paper follows Radford (1986). For more specific terms applied to the Asteraceae I have followed Jeffrey (2007).

The descriptions in this paper were prepared using the DELTA suite of programs (Dallwitz 1980; Dallwitz *et al.* 1993) and edited to improve readability. The maps were prepared using the program *DIVA-GIS* (Hijmans *et al.* 2006). Distributions are summarised in terms of the *Interim Biogeographic Regionalisation for Australia (IBRA) version 6.1*, established by Department of the Environment, Water, Heritage and the Arts (2008) and the Western Australian Botanical Provinces delineated by Beard (1989).

Crisp (1983) has argued that where lectotypification has not yet been made, Preiss' specimens at LD annotated by Steetz have equal status as original material to those from Steetz's own herbarium, now at MEL. However, as Short (1983) has observed, those of the latter category are designated as new taxa by the word 'nobis!' after each name. Thus, in all such cases considered in the present paper, specimens from MEL annotated by Steetz are selected as lectotypes. Further notes on specimens collected by Preiss can be found in Lander (1987).

Other than type material, only a brief selection of specimens examined of each species are listed here. A delimited text file containing label details of some 15,000 *Olearia* specimens from Australian and European herbaria examined in the course of my studies of this genus is available on request.

Key to *Olearia* species discussed in this paper

1. Leaves smooth to the touch; carpopodium conspicuous

  2. Always at least some leaves with 1–4 lobes which extend as much as 3/4 distance to midrib; outer involucral bracts elliptic to ovate..**O. paucidentata**

  2: All leaves entire; outer involucral bracts obovate to obtriangular

    3. Heads sessile or subsessile; ray florets 10–11.5 mm long; disc florets 4.2–5.0 mm long; anthers 2.0–2.2 mm long; filament collars 0.4–0.5 mm long; styles with arms 1.2–1.4 mm long; achenes 1.5–2.0 mm long × 0.8–1.4 mm wide; pappus with 10–12 short bristles (as well as longer ones)..**O. lehmanniana**

    3: Heads pedunculate; ray florets 5.1–9.0 mm long; disc florets 2.8–4.0 mm long; anthers 1.1–1.5 mm long; filament collars 0.1–0.3 mm long; styles with arms 0.7–1.0 mm long; achenes 0.6–0.7 mm long × 0.2–0.4 mm wide; pappus with 2–5 short bristles (as well as longer ones)..**O. elaeophila**

1: Leaves distinctly rough to the touch, hispid to scabrous; carpopodium conspicuous or inconspicuous

  4. Heads solitary; inner involucral bracts subglabrous to weakly hairy; ray florets 10.0–13.5 mm long, ligules 7.0–9.5 mm long; disc florets 5–6 mm long, the lobes 1.0–1.5 mm long; anthers 2.0–25 mm long, filament collars 0.3–0.4 mm long; achene with inconspicuous carpopodium..**O. strigosa**

  4: Heads borne in compound corymbs or panicles; inner involucral bracts densely hairy; ray florets 6.5–8.5 mm long, ligules 4.4–6 mm long; disc florets 3.5–4.2 mm long, lobes 0.4–0.6 mm long; anthers 1.6–1.7 mm long, filament collars 0.2–0.35 mm long; achene with a well-developed carpopodium..**O. muricata**

Olearia paucidentata (Steetz) F.Muell. ex Benth. *Fl. Austral.* 3: 485 (1867). — *Eurybia paucidentata* Steetz in Lehm. *Pl. Preiss.* 1: 420–421 (1845). — *Shawia paucidentata* (Steetz) Sch.Bip., *Polichia* 18–19: 174 (1861). — *Aster paucidentatus* (Steetz) F.Muell., *Fragm.* 5: 66 (1865, 1866). *Type*: In glareosia sylvae planitiei montis Greenmount, 26 April 1840, *L. Preiss* 84 (*lecto*, here designated: MEL 547137; *isolecto*: K).

Eurybia paucidentata var. *hispida* Steetz in Lehm. *Pl. Preiss.* 1: 420–421 (1845). *Type*: In glareosia sylvae planitiei montis Greenmount, 26 April 1840, *L. Preiss* 84 (*holo*: MEL 547137; iso: K).

Eurybia paucidentata var. *subracemosa* Steetz in Lehm. *Pl. Preiss.* 1: 420–421 (1845). *Type*: In planitie arenosa supra oppidulum Guildford, *L. Preiss* 80 *p.p.*, 21 March 1839 (*lecto* here designated: MEL1547136; isolecto: K, LD, P, S).

Eurybia paucidentata var. *glabrata* Steetz in Lehm. *Pl. Preiss.* 1: 420–421 (1845). *Type*: In solo humoso supra oppidulum Guildford ubique, 1 July 1839, *L. Preiss* 74 (*lecto*, here designated: MEL1547134; *isolecto*: G, LD, MEL1547135, S).

Olearia paucidentata var. *latifolia* Benth., *Fl. Austral.* 3: 485 (1867). *Types*: Swan River, *J. Drummond* 2/172, 1843 (*lecto*, here designated: K – photo PERTH; *isolecto*: MEL1547114, BM, G, P); Plantagenet and Stirling Range, [*G. Maxwell s.n.*], *s. dat.* (residual *syntype*: MEL1547113); Porongurup Ranges, *G. Maxwell* [as 'Mx'], *s. dat.* (residual *syntype*: K – photo PERTH) – see *Typification* below.

Shrub to 1.2 m high; vegetative surfaces ± resinous, glandular and arachnoid-lanate; stems cream, olive-green with purple tinges (mainly in axes), brown or grey; bark smooth. *Leaves* alternate and (sometimes) fasciculate, scattered or crowded, ascending or divergent, sessile, subsessile or petiolate, stem-clasping; petiole 2 mm long; lamina flat, heteromorphic, elliptic, linear, obovate, ovate, spathulate, triangular or cuneate, 1–35 mm long × 0.5–10.0 mm wide, concolorous or discolorous, dark green abaxially, grey-green adaxially, herbaceous, smooth to the touch but with shiny colliculate surfaces, abaxially subglabrous to weakly hairy with multicellular, uniseriate, simple and biseriate, vesicular trichomes, adaxially glabrous to subglabrous with multicellular, uniseriate, simple trichomes; base acute, attenuate or truncate; margin revolute or flat, irregularly lobed to entire (always at least some leaves 1–4-lobed, the lobes sometimes extending as much as 3/4 distance from outer margin of lamina to midrib); apex acute, obtuse or rounded, muticous or mucronulate. *Heads* terminal, in panicles or (occasionally) in simple leafy corymbs, shortly pedunculate, conspicuously radiate, 10–25 mm wide; disc 4–10 mm in diameter; peduncles to 30 mm long × 0.5–1.2 mm in diameter; peduncular bracts absent or 1–4 and then distinct from or grading into those of the involucre. *Involucre* conic, turbinate or cup-shaped; involucral bracts 4–6-seriate, 2.5–4.3 mm long × 0.6–0.8 mm wide. Outer involucral bracts cymbiform or flat, elliptic or ovate, glabrous to weakly hairy abaxially with unicellular, simple and multicellular, uniseriate, simple and biseriate, vesicular trichomes; stereome yellow, green or brown; margin cartilaginous, ciliate; apex acute or rounded, the same colour as the stereome or red. Inner involucral bracts cymbiform or flat, elliptic, abaxially glabrous with unicellular and multicellular, biseriate, vesicular (sometimes glandular trichomes; stereome yellow, green or brown; margin cartilaginous, fimbriate; apex acute or rounded, the same colour as the stereome or faintly red. *Receptacle* convex. *Ray florets* 12–16, uniseriate, 7–9 mm long, white, mauve, blue or purple; floral tube glabrous to weakly hairy abaxially with biseriate simple and occasionally unicellular trichomes; ligule elliptic, obovate or oblong, 4.6–6 mm long × 1.3–2 mm wide, glabrous to subglabrous with multicellular, uniseriate and biseriate, simple trichomes; stylar arms ligulate, 1.1–1.4 mm long × 0.1–0.15 mm wide. *Disc florets* 13–56, mauve or yellow (although sometimes only the styles are yellow), narrowly infundibular, 3.5–4.0 mm long, subglabrous; trichomes biseriate, simple; lobes 5, 0.8–1.3 mm long, acute. Anthers 1.4–1.8 mm long; basal lobes acute or fused to the filament collar, 0.2 × the length of the filament collar; filament collar 0.3 mm long; sterile appendage ovate. Stylar arms 0.75–1.25 mm long × 0.2–0.3 mm wide; sterile appendage ligulate or sometimes half-clavate, with botuliform or cylindric sweeping-hairs. *Achenes* ellipsoid, botuliform or obovoid, 1.0–1.2 mm long × 0.4–0.5 mm wide, green, yellow or brown, weakly to densely sericeous or strigillose with duplex hairs and biseriate, vesicular trichomes; venation ± distinct; ribs 4; base acute or truncate; carpopodium conspicuous; apex acute or truncate. *Pappus* 0.8 × the length of the tubular florets; bristles uniseriate, white or straw-coloured, barbellate; long bristles 21–33; short bristles 10–16.

Selected specimens examined (from a total of 355). WESTERN AUSTRALIA: Pallinup Riverside, E of Albany, 15 Feb. 1982, *E.J. Croxford* 1787 (PERTH 4468821); Yandegin, 1890, *A. Eaton s.n.* (MEL); Lesueur National Park, 22 Mar. 1993, *B. Evans* WE 491 (PERTH 07719744); King George Sound, *s. dat.*, *C.G.F. von Hochstetter s.n.* (P); 1.6 km W of Wongan Hills on Wongan Hills – Piawaning Rd, 14 May 1980, *K.F. Kenneally* 7201 (PERTH 529281); Cape Leeuwin, 27 Dec. 1962, *F. Lullfitz* 2051 (PERTH 00529354); Busselton, Mar. 1898, *A. Morrison* 8591 (K); Fremantle, *s. dat.*, *A.F. Oldfield s.n.* (MEL - 2 sheets); Boranup, 8 km NW of Karridale, Nov. 1982, *A. Strid* 21396 (CO, K, MEL); Point Nuyts, near bridge, Oct. 1968, *J.W. Wrigley* CBG 036515 (CBG).

Distribution. Geraldton Sandplains, Swan Coastal Plain, Jarrah Forest, Warren, Avon Wheatbelt, Mallee, Coolgardie and Esperance Plains Bioregions in the South-west Botanical Province of Western Australia (Figure 1).

Flowering period. Throughout the year.

Habitat. In low to tall open forest (Jarrah, Karri, Marri, Wandoo), in loam, clayand red to white sand, over limestone, granite and gneiss.

Conservation status. Widespread and common in south-west Western Australia.

Typification. The name *Eurybia paucidentata* Steetz is legitimately published. However, Steetz named and described three variants of this species, to none of which he gave the varietal epithet *paucidentata*; nor does he cite a specimen with his description of the species itself. Thus *E. paucidentata* is lectotypified above by the type of *E. paucidentata* var. *hispida*.

Specimens bearing *Plantae Preissianae* number 80 variously represent types of *Eurybia elaeophila* DC. and *E. paucidentata* var. *subracemosa* Steetz. Those of the former are generally annotated *Preiss* 80a; those of the latter simply *Preiss* 80. The mixed nature of this collection is further evidenced by Preiss' field numbers attached to several of these specimens. A specimen belonging to *Olearia paucidentata* held at K is numbered *J.A.L. Preiss* 32. Otherwise its label data is fully consistent with that of the lectotype (LD) and isolectotype (MEL) of *E. paucidentata* var. *subracemosa* cited above. This specimen would appear to be from amongst specimens bearing Preiss' field numbers purchased by William Hooker directly from the collector prior to the distribution of his collections bearing *Plantae Preissianae* numbers (Lander 1987: 8). Thus it is considered here to be an isolectotype of *E. paucidentata* var. *subracemosa*.

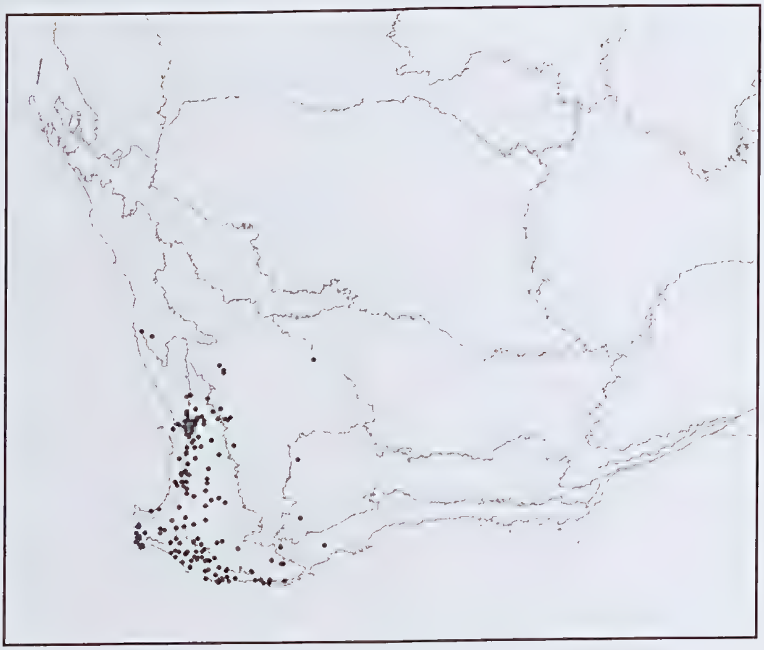

Figure 1. Distribution of *Olearia paucidentata* (●).

Original material of *Olearia paucidentata* var. *latifolia* held at MEL, namely *Maxwell* (MEL 1547113) and *Drummond* 172 (MEL 1547114) have both been annotated by Bentham with his customary 'B'and are thus here designated as residual syntypes.

Of his *Eurybia paucidentata* var. *hispida*, Steetz (*loc. cit.*) notes 'Unicum tantum specimen exstat, et hoc insuper mancum'. Only a single, incomplete specimen exists. Thus the Preiss specimen at MEL is here considered to be the holotype of this name. An isotype (unseen by Steetz) is at K.

Affinities. This species was included by Bentham (1867) in *Olearia* sect. *Merismotriche* where it bears a strong resemblance to both *O. elaeophila* and to *O. lehmanniana*. These three species are broadly sympatric north of Perth and have been much confused in herbarium collections.

Olearia paucidentata differs from *O. elaeophila* in its vestiture which is glandular or strigose rather than arachnoid or lanate; leaf lamina with margins both entire and irregularly lobed (i.e. always at least some leaves with 1–4 lobes sometimes extending as much as 3/4 distance to the midrib from the outer margin of the lamina) rather than always entire and never toothed or lobed; outer involucral bracts which are elliptic or ovate rather than triangular; pappus with 10–16 rather than 2–5 short bristles.

Olearia paucidentata differs from *O. lehmanniana* in its vestiture which is glandular or strigose rather than arachnoid or lanate; heads borne in simple corymbs or panicles rather than solitary or in racemes, and pedunculate rather than sessile to subsessile; outer involucral bracts which are elliptic or ovate rather than obovate or triangular; ray florets which are 7–9 mm rather than 10.0–11.5 mm long, with ligules 4.6–6.0 mm rather than 7.5–8.5 mm long; disc florets 3.5–4.0 mm rather than *c.* 4.2–5.0 mm long, with anthers 1.4–1.8 mm rather than 2.0–2.2 mm long, and filament collars *c.* 0.3 mm rather than 0.4–0.5 mm long; achenes 1–1.2 × 0.4–0.5 mm rather than 1.5–2 × 0.6–7.0 mm; pappus uniseriate rather than biseriate.

Olearia elaeophila (DC.) F.Muell. ex Benth., *Fl. Austral.* 3: 484 (1867). — *Eurybia elaeophila* A.Cunn. ex DC,. *Prod.* 5: 269 (1836). — *Aster elaeophilus* A.Cunn. ex DC., *loc. cit., pro syn* (*nom. inval.*) — *Aster heleophilus* (DC.) F.Muell., *Fragm.* 5: 66 (1865, 1866). — *Olearia heleophila* F.Muell., *loc. cit., pro syn.* (*nom. inval.*) *Type*: ... in paludosis ad ripa alcus dicti Lagoon in sinu Regis Georgii ad oram merid.-occid. Novae Hollandiae, 9 January 1818, *A. Cunningham* 37 (*holo*: G-DC).

Eurybia affinis Steetz in Lehm. *Pl. Preiss.* 1: 421–422 (1845). — *Shawia affinis* (Steetz) Sch.Bip., *Pollichia* 18–19: 174 (1861). *Type*: In planitie arenosa supra oppidulum Guildford, 21 March 1839, *L. Preiss* 80 *ex parte* (*lecto*, here designated: MEL1547097; *isolecto*: K– photo PERTH, LD, MEL1547085, MEL1547095, P).

Eurybia paniculata Steetz, in Lehm. *Pl. Preiss.* 1: 422–423 (1845). — *Shawia steetzii* Sch.Bip., *Pollichia* 18–19: 174 (1861), non *Shawia paniculata* J.R.Forst. & G.Forst., *Char. Gen. Pl.*: 95, t. 48 (1776). — *Aster preissii* F.Muell., *Fragm.* 5: 66 (1865, 1866), *pro syn.* (*nom. inval.*) *Type*: In solo sublimoso vallis montis Warriup, districtus Hay, February 1841, *L. Preiss* 81 *(lecto*, here designated: MEL1547098; *isolecto*: K, LD, MEL1547099, P, S).

Shrub to 0.5 m high; vegetative surfaces glandular- and sparsely arachnoid-hairy to lanate; stems ascending, green or brown; bark smooth. *Leaves* alternate and ± fasciculate, scattered, appressed, ascending or inclined, sessile, subsessile or petiolate, clasping; petiole to 2 mm long; lamina incurved, recurved (and sometimes falcate) or flat, linear or occasionally elliptic, 2–30 mm long × 0.25–2.5 mm wide, concolorous, yellow, green or grey, herbaceous, smooth, abaxially glabrous to subglabrous with unicellular trichomes and scattered multicellular, uniseriate, simple and multicellular, biseriate, vesicular trichomes, adaxially glabrous to subglabrous with extremely few, unicellular and multicellular, uniseriate, simple trichomes; base acute to truncate; margin entire, revolute or involute; apex acute, muticous or mucronulate. *Heads* terminal, in panicles or racemes, pedunculate, conspicuously radiate, 8–17 mm in diameter; disc 5–8 mm in diameter; peduncle 4–10 mm long × 0.25–0.75 mm in diameter; peduncular bracts up to 4, grading into those of the involucre. *Involucre* conic or hemispheric; involucral bracts 3–6-seriate, 1.2–3.5 mm long × 0.6–1.0 mm wide, cymbiform or flat. Outer involucral bracts triangular, abaxially glabrous to densely hairy with unicellular and multicellular, uniseriate, simple trichomes; stereome yellow or green; margin membranous, fimbriate or ciliate; apex acute, pinkish red or faint orange. Inner involucral bracts cymbiform or flat, elliptic or ovate, abaxially glabrous to densely hairy with unicellular and multicellular, uniseriate, simple and biseriate, vesicular trichomes; margin membranous, entire or fimbriate; apex acute, pinkish red. *Receptacle* flat or convex. *Ray florets* 10–17, uniseriate, 5.1–9 mm long, white or blue; floral tube abaxially subglabrous or weakly hairy with multicellular, biseriate, simple trichomes; ligule linear, elliptic or obovate, 3.5–7.5 mm long × 0.9–1.9 mm wide, glabrous; stylar arms ligulate, 0.7–1.5 mm long × 0.1 mm wide. *Disc florets* 7–18, yellow or (rarely) violet, infundibular or campanulate (one specimen greatly swollen basally), 2.8–4.0 mm long, subglabrous with multicellular, biseriate, simple trichomes; lobes 5, 0.8–1.0 mm long, acute. Anthers 1.1–1.5 mm long; basal lobes rounded or fused to the filament. Stylar arms 0.7–1.0 mm long × 0.1–0.2 mm wide; sterile appendage half-clavate or ligulate, with botuliform sweeping-hairs. *Achene* ellipsoid, botuliform or obovoid, 0.8–1.4 mm long × 0.2–0.4 mm wide, orange-yellow or brown, densely hairy, with duplex hairs and ± strigillose multicellular, biseriate, vesicular trichomes; venation indistinct; base acute or truncate; carpopodium conspicuous; apex truncate. *Pappus* equal or subequal in length to the tubular florets, uniseriate or biseriate; bristles white or straw-coloured, sometimes orange at base, barbellate; long bristles 18–29; short bristles 2–5.

Selected specimens examined (from a total of 96). WESTERN AUSTRALIA: Walpole Nornalup National Park, 11 Apr. 1989, *A.R. Annels* 707 (PERTH 02654857); Bunbury, Mar. 1903, *C.R.P. Andrews s.n.* (PERTH 00450499); Mt Lesueur, on track from Jurien Bay Rd, 21 Feb. 1970, *T.E.H. Aplin* 2988 (PERTH 00674761); West Perth, *s. dat.*, *W.E. Blackall s.n.* (PERTH 00450464); King George Sound [as 'King George III Sound'], Dec. 1801, *R. Brown* 2252 (BM); Cape Naturaliste, *s. dat.*, *[R.] Collie s.n.* (K); Cape Leuwin, *s. dat.*, *[R.] Collie s.n.* (K); Busselton, *s. dat.*, *A. & E. Pries s.n.* (MEL); Toolibin townsite, 12 Mar. 1986, *L. Silvester s.n.* (PERTH 00803278); Dingo Rock Reserve, 6 miles [9.7 km] W of Manmanning, 14 June 1985, *B.H. Smith* 583 (AD, CBG, HO, MEL, NSW, PERTH 799076); Point Ann [as Point Anne], Fitzgerald River National Park, 21 May 1991, *R.T. Wills s.n.* (PERTH 06424198).

Distribution. Geraldton Sandplains, Swan Coastal Plain, Jarrah Forest, Avon Wheatbelt, Warren, and Esperance Plains Bioregions in the South-west Botanical Province of Western Australia (Figure 2).

I have tentatively identified a specimen at K collected by Richard Helms at Victoria Desert Camp 56 (18 September 1891) as this species, though it seems highly dubious at this locality and it is likely that the label information is in error.

Habitat. Amongst sedge-land, heath, low, closed shrubland, low, open woodland and low, open forest, in winter-wet depressions, on flats, river foreshores and gentle slopes or around rocky outcrops, in peat, gravelly sand and sandy clay over laterite and around granite outcrops.

Flowering period. April and May.

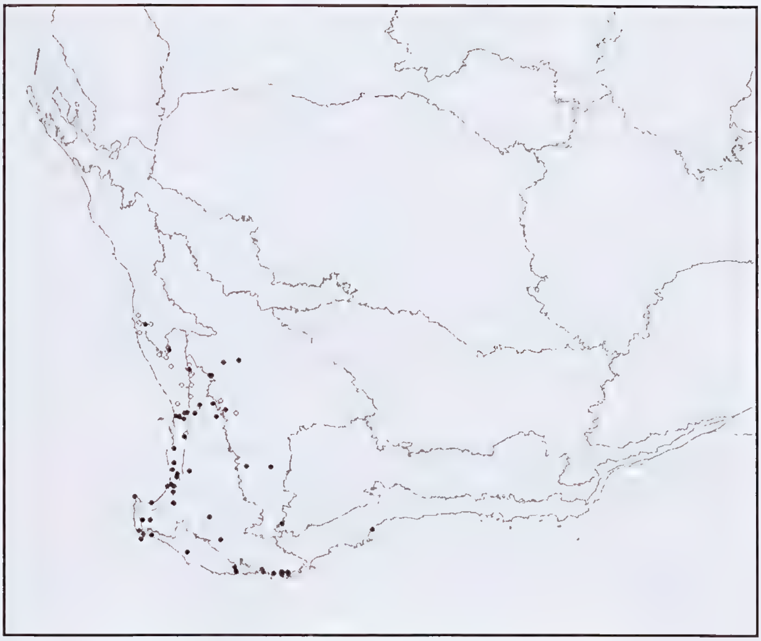

Figure 2. Distribution of *Olearia elaeophila* (●) and *O. lehmanniana* (○).

Conservation status. Widespread and common in south-west Western Australia.

Typification. The isolectotypes of *Eurybia affinis* Steetz at K and MEL1547085 bear the field location number 32 used by Preiss rather than the formal collection numbers used in *Plantae Preissianae*.

Affinities. This species was included by Bentham (1867) in *Olearia* sect. *Merismotriche* where it appears most similar to *O. paucidentata* (see above for distinguishing features) and *O. lehmanniana* (see below). These three species are broadly sympatric north of Perth and have been much confused in herbarium collections.

Olearia lehmanniana (Steetz) Lander, *comb. nov.*—*Eurybia lehmanniana* Steetz in Lehm. *Pl. Preiss.* 1: 422 (1845).—*Shawia lehmanniana* (Steetz) Sch.Bip., *Pollichia* 18–19: 174 (1861).—*Aster lehmannii* F.Muell., *Fragm.* 5: 66 (1865, 1866), *pro syn.* (*nom inval.*)—*Olearia heleophila* var. *major* Benth., *Fl. Austral.* 3: 484 (1867). *Type*: In arenosis inter frutices supra oppidulum Perth, 14 April 1839, *L. Preiss* 79 (*lecto*, here designated: MEL1547092; *isolecto*: CO, FL, FL-W, G-2 specimens, K – with field number 147, L, LD, MEL 1547093 & 1547094 & 1547096, P, S – *n.v.*, WRSL).

Olearia conspicua Lander & S.Harris ex Paczkowska & Chapman, West. Austral. Fl.: Descr. Cat. p. 168 (2000) *nom. nud.*

Shrub to 1.3 m high × 0.3 m wide; vegetative surfaces glandular and arachnoid hairy to lanate; stems green, brown or grey; bark smooth. *Leaves* alternate and sometimes fasciculate, scattered, appressed, ascending or inclined, sessile and stem-clasping, subsessile or petiolate; petiole to 1 mm long; lamina incurved, recurved or flat, elliptic or linear, sometimes falcate, 2–20 mm long × 0.5–2.0 mm wide, concolorous, yellow, green or grey, herbaceous, smooth, abaxially densely hairy with unicellular, and multicellular, uniseriate, simple and biseriate, vesicular trichomes, adaxially subglabrous to weakly hairy with unicellular and multicellular, uniseriate, simple trichomes; base acute or truncate; margin flat or revolute, entire; apex acute, muticous or mucronulate. *Heads* terminal, solitary or in racemes, sessile or subsessile, conspicuously radiate, 9–24 mm in diameter; disc 7–14 mm in diameter; involucre conic; involucral bracts 5–7-seriate, 2.5–4.7 mm long × 0.8–1.2 mm wide. Outer involucral bracts flat, obovate or triangular, abaxially subglabrous to densely hairy with unicellular, multicellular, uniseriate, simple and biseriate, vesicular trichomes; stereome green or brown; margin chartaceous, entire, fimbriate or ciliate; apex acute, the same colour as the stereome or pinkish red. Inner involucral bracts flat, elliptic; abaxially glabrous to densely hairy with unicellular and multicellular, uniseriate, simple and biseriate, vesicular trichomes; stereome yellow or green; margin membranous, fimbriate; apex acute, purple or pinkish red. *Receptacle* flat or convex. *Ray florets* 9–16, uniseriate, 10.0–11.5 mm long, pale mauve; floral tube weakly to densely hairy abaxially, with biseriate, simple trichomes.; ligule elliptic or obovate, 7.5–8.5 mm long × 1.7–2.5 mm wide, glabrous; staminodes present or absent; stylar arms ligulate, 1.0–1.2 mm long × 0.08–0.20 mm wide. *Disc florets* 17–20, infundibular, 4.2–5.0 mm long, subglabrous, with biseriate, simple trichomes; lobes 5, 1.2–1.5 mm long, acute. Anthers 2.0–2.2 mm long; basal lobes acute, rounded or tailed or fused to the filament collar, 0.1–0.4 × the length of the filament collar; filament collar 0.4–0.5 mm long; sterile appendages ovate or triangular. Stylar arms 1.2–1.4 mm long × 0.2–0.3 mm wide, half-clavate or ligulate, with botuliform sweeping-hairs. *Achenes* ellipsoid, 1.5–2.0 mm long × 0.6–0.7 mm wide, orange-brown, densely glandular-hairy or strigillose, with duplex hairs and biseriate, vesicular trichomes; venation indistinct; base acute; carpopodium conspicuous; apex acute. *Pappus* biseriate, with white or straw-coloured, barbellate bristles; long bristles 28–30; short bristles 10–12.

Selected specimens examined (from a total of 26). WESTERN AUSTRALIA: Mundijong, 12 May 1980, *R.J. Cranfield s.n.* (PERTH 00450359); Reserve 24496, 8 km E of Leeman, 20 Mar. 1981, *E.A. Griffin & M.I. Blackwell* 3056 (PERTH 450545); Jurien Bay, S of River Loop Rd, 18 June 2005, *R. Snook* HRTA 153 (PERTH 07267959)Hills, 3 June 2005, *A. Sole & H. Green* NP18 (PERTH 07321473).

Distribution. Geraldton Sandplains, Swan Coastal Plain, Avon Wheatbelt and Jarrah Forest Bioegions in the South-west Botanical Province of Western Australia (Figure 2).

Habitat. Amongst swamp, low heath, shrubland, woodland, forest, on flats, river banks, slopes, and ridges; in gravely clay, loam, silt and sand; over limestone, granite and laterite.

Flowering period. February to April.

Conservation status. Widespread and common in south-west Western Australia.

Typification. The isolectotype of *Eurybia lehmanniana* Steetz at K bears the field location number 147 used by Preiss rather than the formal collection numbers used in *Plantae Preissianae*.

Affinities. This species was subsumed by Bentham (1867) under *Olearia paucidentata* which he placed in section *Olearia* sect. *Merismotriche*. For distinguishing features between these two species see above.

Olearia lehmanniana is, perhaps, most similar to *O. elaeophila* from which it can be distinguished by its heads which are sessile or subsessile rather than pedunculate; ray florets which are 10.0–11.5 mm rather than 5.1–9.0 mm long; disc florets which are *c.* 5 mm rather than 2.8–4.0 mm long, with lobes *c.* 1.2 mm rather than 0.8–1.0 mm long, anthers 2.0–2.2 mm rather than 1.1–1.5 mm long, filament collars 0.4–0.5 mm rather than 0.1–0.3 mm long, and styles with arms 1.2–1.4 rather than 0.7–1.0 mm long; achenes which are 1.5–2 × 0.8–1.4 mm rather than 0.6-0.7 × 0.2–0.4 mm; pappus which has 10–12 rather than 2–5 short bristles.

These three species are broadly sympatric north of Perth and have been much confused in herbarium collections.

Olearia strigosa (Steetz) Benth., *Fl. Austral.* 3: 485 (1867). — *Eurybia strigosa* Steetz, Lehm. *Pl. Preiss.* 1: 419–420 (1845). — *Shawia strigosa* (Steetz) Sch.Bip., *Pollichia* 18–19: 174 (1861). — *Aster steetzii* F.Muell., *Fragm.* 5: 66 (1865) non *Aster strigosus* Harvey & Sond., *Fl. Cap.* 3: 83 (1865). — *Olearia steetzii* F.Muell., *loc. cit., pro syn., nom. inval. Type*: In arenosis sylvae prope fluvium Vasse-river, 17 December 1839, *L. Preiss* 83 (*lecto*, here designated: MEL1547181; *isolecto*: G, LD, MEL1547180, S).

Eurybia aspera Steetz, in Lehm. *Pl. Preiss.* 1: 420 (1845). — *Shawia aspera* (Steetz) Sch.Bip., *Pollichia* 18–19: 174 (1861). *Type*: [Specimen unicum inveni in herbario Preissiano sine numero et schedula], *L. Preiss s.n.* (*holo*: MEL1547138).

Shrub to 0.5 m high × 0.3 m wide; vegetative surfaces hispid; stems cream, green (sometimes pale), brown or grey; bark smooth. *Leaves* alternate, scattered, appressed, ascending or inclined, sessile to subsessile, stem-clasping; petiole (when present) to 1 mm long; lamina incurved, recurved or flat, linear; 2.5–18.0 mm long × 1.0–2.5 mm wide, concolorous, yellow, green or grey, herbaceous, abaxially subglabrous to densely hairy with unicellular, multicellular, uniseriate, simple and biseriate, vesicular trichomes, adaxially subglabrous with unicellular and multicellular, uniseriate, simple trichomes; base acute or truncate; margin revolute, entire; apex acute, muticous. *Heads* terminal, solitary or in racemes, pedunculate, conspicuously radiate, 11–20 mm in diameter; disc 7–12 mm in diameter. Peduncle to 22 mm long × 0.5–1 mm in diameter; peduncular bracts absent or few to many, grading into those of the involucre. *Involucre* conic or hemispheric; involucral bracts 3–5-seriate, 2.5–6.0 mm long × 0.5–1.8 mm wide. Outer involucral bracts cymbiform or flat, linear, elliptic or triangular, abaxially subglabrous to densely hairy with unicellular, multicellular, uniseriate, simple and biseriate, vesicular trichomes; stereome yellow or green; margin chartaceous, membranous or herbaceous, entire or ciliate; apex acute, the same colour as the stereome. Inner involucral bracts cymbiform or flat, linear; abaxial vestiture glabrous to densely hairy with unicellular, multicellular, uniseriate, simple and biseriate, vesicular trichomes; stereome green or yellow; margin chartaceous or membranous, fimbriate, entire or ciliate; apex acute, the same colour as the stereome. *Receptacle* convex. *Ray florets* 7–11, uniseriate, 10.0–13.5 mm long; floral tube glabrous to densely hairy abaxially, with unicellular, multicellular, uniseriate and biseriate, simple trichomes; ligule elliptic or obovate, 7.0–9.5 mm long × 1.8–2.5 mm wide, glabrous; *stylar arms* filiform or ligulate, 1–2 mm long × 0.1–0.2 mm wide. *Disc florets* 9–30, infundibular or conic, 5–6 mm long, glabrous to densely hairy with multicellular, biseriate, simple trichomes; lobes 5, 1.0–1.5 mm long, acute. Anthers 2.0–2.5 mm long; basal lobes acute, 0.1–0.2 × the length of the filament collar; filament collar 0.3–0.4 mm long; sterile appendage triangular (occasionally almost linear). *Stylar arms* 1–2 mm long × 0.1–0.3 mm wide; sterile appendage half-clavate or ligulate, with botuliform sweeping-hairs. *Achene* ellipsoid, botuliform or obovoid, 1.1–2.0 mm long × 0.2–0.4 mm wide, green, yellow, brown or grey, densely sericeous, with duplex hairs and multicellular, biseriate, vesicular trichomes; venation indistinct; base acute or truncate; carpopodium inconspicuous; apex acute or truncate. *Pappus* 0.8–1.0 × the length of the tubular florets, uniseriate or biseriate; bristles white or straw-coloured, barbellate; long bristles 30–56; short bristles 4–10(–20).

Other specimens examined. WESTERN AUSTRALIA: Carbunup River crossing on road from Busselton to Margaret River, 21 Jan. 1979, *B. Barnsley* 820 (CBG, PERTH 789216); Dunsborough, Dec. 1963, *J.S. Beard* 3145 (KPBG); Marri Reserve 28683, Cape Naturaliste Road, Dunsborough, 15 Dec. 2003, *H. Cole & D. Carter* 658 (PERTH 06837727); between Wagerup & Yarloop, 9 Apr. 1955, *J.W. Green* 318 (PERTH 00676438); Kemp Road, base of Whicher Range, 28 Jan. 2004, *G.J. Keighery* 16441 (PERTH 07188293); *s. loc.*, 1860, *G. Maxwell s.n.* (PERTH 01622595); Ludlow, 23 Mar. 1898, *A. Morrison s.n.* (P); Busselton, Mar. 1898, *A. Morrison* 8591 (ED, K, P); Harvey River, Dec. 1877, *F.[J.H.] Mueller* (MEL); Coolilup [as Coolicup], 29 Dec. 1939, *T.N. Stoate s.n* (PERTH 00675962 & 00675970); Boyanup, May 1912, *F. Stoward* 145 (NSW).

Distribution. Restricted to the southern part of the Swan Coastal Plain Bioregion in the South-west Botanical Province of Western Australia (Figure 3).

Habitat. Amongst low, open woodland with understorey of herbs, low and tall sedges, on undulating flats, in grey sandy clay and pale brown loam.

Flowering period. December to May.

Conservation status. Despite its restricted distribution and infrequent collection this species does not appear to be rare or threatened.

Typification. The specimen taken to be the holotype of *Eurybia aspera* is from the personal herbarium of Steetz (now at MEL) and is the only one encountered labelled with this name by Steetz himself. On the sheet Steetz notes that this specimen was segregated from Preiss' collection of *Eurybia paucidentata* var. *hispida*, namely *Preiss* 84 from Greenmount.

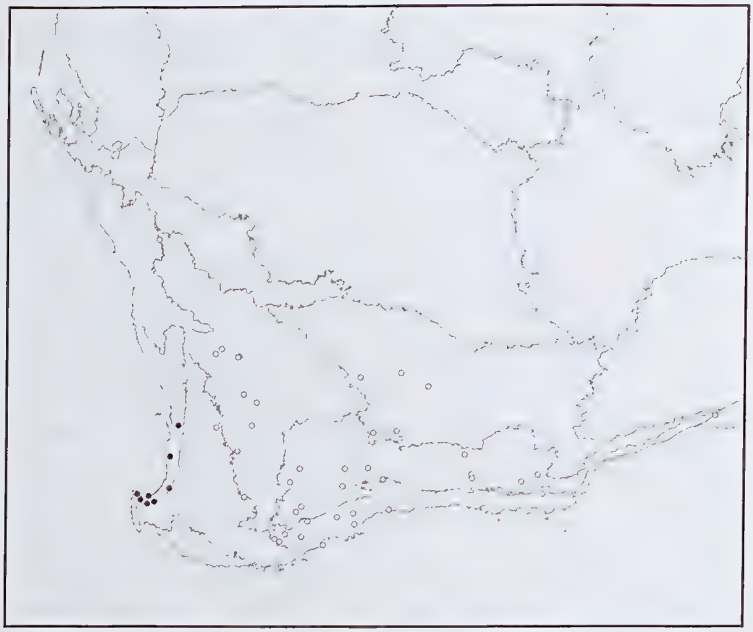

Figure 3. Distribution of *Olearia strigosa* (●) and *O. muricata* (○).

Affinities. This species was included in *Olearia* section *Merismotriche* by Bentham where it appears most similar to *O. muricata*, from which it can be distinguished by its heads which are solitary rather than borne in compound corymbs or panicles; its inner involucral bracts which are subglabrous or weakly hairy rather than densely hairy; its ray florets which are 10.0–13.5 mm rather than 6.5–8.5 mm long, with ligules 7.0–9.5 rather than 4.4–6 mm long; its disc florets which are 5–6 mm rather than 3.5–4.2 mm long, with lobes 1.0–1.5 rather than 0.4–0.6 mm long, and anthers 2.0–2.5 rather than 1.6–1.7 mm long with filament collars 0.3–0.4 rather than 0.20–0.35 mm long; and its achene with carpopodium inconspicuous rather than well-developed. From Figure 3 it can be seen that these two species are decidedly allopatric, separated (but for a single specimen of *O. muricata*) by the Jarrah Forest Bioregion.

Olearia muricata (Steetz) Benth., *Fl. Austral*. 3: 484-485 (1867). — *Eurybia muricata* Steetz, in Lehm. *Pl. Preiss*. 1: 423 (1845). — *Shawia muricata* (Steetz) Sch.Bip. (1861: 174). — *Aster muricatus* (Steetz) F.Muell., *Fragm*. 5: 66 (1865, 1866). *Type*: In promontorio Cape-Riche, [34° 36' S, 118° 47' E], November 1840, *L. Preiss* 82 (*lecto*, here designated: MEL1547133; *isolecto*: G, LD, MEL 1547131).

Eurybia leptophylla Turcz., *Bull. Soc. Imp. Natural. Moscou* 24(1): 171 (1851). — *Shawia leptophylla* (Turcz.) Sch.Bip., *Pollichia* 18–19: 175 (1861). *Type*: Swan River, *s. dat.*, *J. Drummond* 3/127 (*holo*: KW; *iso*: P; possible *iso*: CGE, K, MEL681595, P, PERTH 00529540).

Shrub to 1 m high; vegetative surfaces scabrous; stems green or brown; bark smooth or plated. *Leaves* alternate, fasciculate or whorled, scattered or crowded, appressed, ascending or inclined, sessile to subsessile, stem-clasping or decurrent; lamina recurved to flat, linear, triangular to (sometimes) narrowly elliptic, 2–10 mm long × 0.7–2.0 mm wide, concolorous, olive or green, herbaceous, smooth (but with shiny colliculate surfaces), abaxially densely hairy with unicellular, multicellular, uniseriate, simple and biseriate, vesicular trichomes, adaxially subglabrous to weakly hairy with unicellular, multicellular, biseriate, vesicular or simple trichomes; base truncate or (occasionally) acute; margin entire, revolute or flat; apex acute or rounded, muticous. *Heads* terminal, in panicles or (occasionally) in leafy compound corymbs, pedunculate, conspicuously radiate, 8–20 mm in diameter; disc 7–12 mm in diameter; peduncle to 25 mm long × 0.50–0.75 mm in diameter; peduncular bracts absent or up to 4, grading into those of the involucre. *Involucre* conic, involucral bracts 4-seriate, 1.8–4.8 mm long × 0.5–0.8 mm wide. Outer involucral bracts cymbiform or flat, linear, elliptic, ovate or oblong, abaxially subglabrous to densely hairy, with unicellular, multicellular, uniseriate, simple, biseriate, simple and biseriate, vesicular trichomes; stereome green; margin membranous to herbaceous, entire; apex acute, the same colour as the stereome. Inner involucral bracts cymbiform or flat, linear, obovate or oblong, abaxially subglabrous to densely hairy with unicellular, multicellular uniseriate, simple and biseriate, vesicular trichomes; stereome yellow or green; margin membranous, entire or fimbriate; apex acute, the same colour as the stereome or pale red. *Receptacle* flat or convex. *Ray florets* 8–10, uniseriate; 6.5–8.5 mm long; white or pale mauve; floral tube abaxially densely hairy, with biseriate, simple trichomes; ligule elliptic, 4.4–6.0 mm long × 1.8 mm wide, glabrous; stylar arms ligulate, 0.6–1.0 mm long × 0.1 mm wide. *Disc florets* 11–16, yellow (some purple-tipped), infundibular, 3.5–4.2 mm long, subglabrous, with biseriate, simple and vesicular trichomes; lobes 5, 0.4–0.6 mm long, acute. Anthers 1.6–1.7 mm long; basal lobes acute, 0.10–0.25 × the length of the filament collar; filament collar 0.20–0.25 mm long; sterile appendage ovate or triangular. Stylar arms 0.7–1.0 mm long × 0.1–0.2 mm wide, half-clavate, with botuliform sweeping-hairs. *Achene* ellipsoid or obovoid, 1.3–1.6 mm long × 0.4–0.5 mm wide, green, yellow or brown, densely sericeous, with duplex hairs; venation indistinct; base acute; carpopodium conspicuous; apex acute or truncate. *Pappus* 0.9 × the length of the tubular florets, uniseriate or biseriate; bristles white or straw-coloured, barbellate; long bristles 30–37; short bristles 5–20.

Selected specimens examined (from a total of 46). WESTERN AUSTRALIA: Bebenorin Hill, 11 km NE, 17 Dec. 1989, *W. Archer* 1712891 (PERTH 1698761); Coolgardie, 66 km SW, on Queen Victoria Rock road, 31 Jan. 1979, *B. Barnsley* 1028 (CBG, PERTH 789232); Lake Mears Nature Reserve, 12 Feb. 1998, *R. Davis* 5089, (PERTH 05027411); Kondut, 2 miles [3.2 km] S, 10 Jan. 1960, *A.S. George* 503 (PERTH 00528722); Cape Riche, Mar. 1854, *W.H. Harvey s.n.* (K); Westdale Hill, Wandoo Conservation Park, Beverley, 6 Feb. 2000, *M. Hislop, F. & J. Hort* 926 (PERTH 05541336); Wongan Hills, 15 Feb. 1975, *K.F. Kenneally* 2432, (CANB, PERTH 1214004); Boorabin, Jan. 1906, *A. Morrison* 16011 (K); Woogenilup Rd, off Chester Pass, July 1969, *S.P. Pfeiffer* 25 (PERTH 00674745); Salmon Gums, 36 km S, Mar. 1983, *A. Strid* 22415 *p.p.* (G, K, MEL).

Distribution. Jarrah Forest, Avon Wheatbelt, Mallee, Esperance Plains and Coolgardie Bioregions in the South-west Botanical Province of Western Australia (Figure 3).

Habitat. In woodland with *Eucalyptus wandoo*, mallee shrubland or low heath with *Casuarina* and *Calothamnus*, on flat, gently undulating plains, in loamy sand over granite, shallow sand on laterite, sandy gravel, pale sandy loam, yellow or white sand, sandy clay, and siliceous sand.

Flowering period. Throughout the year.

Typification. The Western Australian collector James Drummond numbered taxa rather than individual gatherings as such. Often such taxon numbers are preceded by a collection number, as is the case with the holotype of *Eurybia leptophylla*, namely *Drummond* 3/127 (KW) and one of its isotypes, *Drummond* 3/127 (P). The Paris isotype bears the date 1845, as does *Drummond* 127 (CGE), which is thus also taken to be an isotype. Specimens of *Olearia muricata* simply labelled *Drummond* 127 without date are considered here to be possible isotypes of *Eurybia leptophylla.*

Although the isotype of *Eurybia leptophylla* held at P was received from BM no duplicate has been located in the latter collection. Similarly, the isotype of this name held at PERTH was received from TCD where no duplicate has been located.

Affinities. This species was included by Bentham (1867) in *Olearia* sect. *Merismotriche* where it appears most similar to *O. strigosa* (see above for distinguishing features).

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New species of *Olearia* (Asteraceae: Astereae) from Western Australia

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Abstract

Lander, N.S. New species of *Olearia* (Asteraceae: Astereae) from Western Australia. *Nuytsia* 18: 97–106 (2008). Two new species of *Olearia* Moench endemic to the Mallee and Coolgardie Bioregions respectively in the South-West Botanical Province of Western Australia are described: *O. newbeyi* Lander and *O. trifurcata* Lander. *Olearia pimeleoides* subsp. *incana* D.A.Cooke, widely distributed across southern Australia, is formally raised to specific rank. Descriptions, distribution maps, illustrations, and notes on affinities, habitat and conservation status are provided for all three species.

Introduction

Prior to the preparation of an account of *Olearia* Moench (Asteraceae) in the ongoing *Flora of Australia* series it is necessary to formally describe a number of new species. The two taxa newly described here were first collected by farmer and botanist Ken Newbey (1936–1988) of Ongerup. Both are endemic to Western Australia where they are restricted to the Mallee and Coolgardie Bioregions. In addition, the combination *Olearia incana* (D.A.Cooke) Lander, previously published illegitimately (Lander 1992) is formalised.

My taxonomic studies of Australian species currently recognized as *Olearia* are ongoing and it is highly likely that generic and infrageneric concepts will change as a result of molecular-phylogenetic studies (Cross *et al.* 2002).

The descriptive terminology used in this paper follows Radford (1986). In particular, I have used 'texture' to refer to the 'substance' or 'consistency' of an organ rather than its surface configuration. For more specific terms applied to the Asteraceae I have followed Jeffrey (2007).

The descriptions in this paper were prepared using the DELTA suite of programs (Dallwitz, 1980; Dallwitz *et al.* 1993) and lightly edited to improve readability. The maps were prepared using the program *DIVA-GIS* (Hijmans *et al.* 2006). Distributions are summarised in terms of the *Interim Biogeographic Regionalisation for Australia (IBRA) version 6.1*, established by Department of the Environment, Water, Heritage and the Arts (2008).

Olearia incana (D.A.Cooke) Lander, *stat. et comb. nov.* — *Olearia incana* Lander in G.J. Harden, *Fl. New South Wales* 3: 192 & fig. (1992), *nom. inval.* — *Olearia pimeleoides* subsp. *incana* D.A.Cooke, *J. Adelaide Bot. Gard.* 7(3): 281 (1985); D.A. Cooke in J.P. Jessop, *Fl. South Australia* 3: 1483–1484).

Type: '*c.* 5 km S of Maralinga, 30.vii.1969, *B. Copley* 2695 (*holo*: AD 96937169).'

Olearia lanatus auct., non *Olearia lanata* Koster, *Nova Guinea, Bot.* 24: 536–537 (1966) – [W.R.] Phillipson, *in sched.* (1938).

Shrub to 1.5 m high; vegetative surfaces glandular and lanate with multicellular, uniseriate, simple and biseriate, vesicular trichomes. Stems ascending, pale brown or grey; bark slightly rough. *Leaves* alternate, scattered or rarely crowded, ascending, sessile or subsessile. Lamina flat, narrowly elliptic or cuneate, 2–18 mm long × 1–4 mm wide, concolorous, white, green, grey (greenish grey, pale grey or white-lanate), sub-coriaceous, smooth; venation indistinct apart from mid-vein; abaxial vestiture densely hairy with multicellular, uniseriate, simple and biseriate, vesicular trichomes; adaxial vestiture densely hairy, with multicellular, uniseriate, simple and biseriate, vesicular trichomes; base cuneate; margin revolute, entire or irregularly and coarsely dentate; apex broadly acute or rounded, muticous. *Heads* terminal, solitary or in clusters of 2 or 3, subsessile, conspicuously radiate, 20–46 mm in diameter; disc 6–12 mm in diameter; peduncular bracts absent; involucre conic (obconic) or hemispheric. *Involucral bracts* 3–6-seriate, 2.5–7.5 mm long × 1.4–2.0 mm wide. *Outer involucral bracts* strongly cymbiform, ovate; stereome green or brown; abaxial vestiture ± uniform, basally glabrous to densely pubescent, apically sparsely to densely pubescent; trichomes multicellular, uniseriate, simple and biseriate, vesicular; margin membranous, fimbriate; apex broadly acute, the same colour as the stereome. *Inner involucral bracts* somewhat cymbiform, elliptic or narrowly triangular; stereome green and brown (apically); abaxial vestiture ± uniform, basally glabrous, apically sparsely or densely pubescent; trichomes multicellular, uniseriate, simple and biseriate, vesicular; margin membranous, fimbriate; apex broadly acute, the same colour as the stereome. *Receptacle* convex. *Ray florets* 11–21, female, 1-seriate, 9.8–21.3 mm long, white. Staminodes absent. Floral tube abaxially glabrous basally to sparsely pubescent apically with biseriate, simple trichomes. *Ligule* glabrous, narrowly elliptic or obovate, 7–17 mm long × 2.3–3.5 mm wide, glabrous; apex minutely 3-lobed. *Stylar arms* narrowly filiform; 1.5–3.2 mm long. *Disc florets* 20–27, bisexual, pale yellow, infundibular, 6.7–9.2 mm long, glabrous basally to sparsely pubescent apically with biseriate, simple trichomes; lobes 5, 1.0–1.5 mm long; apex acute. *Anthers* 2.5–3.6 mm long; basal lobes acute, shorter than the filament collar; filament collar 0.4–0.6 mm long; sterile appendage triangular. *Stylar arms* 1.8–3.0 mm long; sterile appendage half-conic with botuliform sweeping-hairs. *Achene* narrowly ellipsoid, 1.8–2.3 mm long × 0.6–1.0 mm wide, brown, densely sericeous, with duplex hairs and biseriate, vesicular trichomes; venation indistinct; carpopodium conspicuous; apex truncate. Pappus uniseriate or biseriate with 37–56 minutely barbellate, bristles, equal in length to the tubular florets.

Flowering period. July–October.

Selected specimens examined (from a total of 108). WESTERN AUSTRALIA: Kookadine, *s. dat.*, *A. Forrest s.n.* (MEL); Victoria Desert, Camp 39, 22 Sep. 1891, *R. Helms s.n.* (PERTH); Eucla, 1882, *J. Oliver s.n.* (MEL); 'Albion Downs', 13 miles [20.8 km] NW of Woolshed, 17 Sep. 1958, *N.H. Speck* 1476 (PERTH). SOUTH AUSTRALIA: Italowie Creek, Aug. 1979, *P.E. Conrick* 102, (AD); Maitland, Sep. 1890, *W. Gill* 157 (MEL); Quorn [as 'Flinders Range'], May 1900, *M. Koch* 240 (ED, MEL); Fowlers Bay, 1880, *A.F. Richards s.n.* (MEL). VICTORIA: Swan Hill, Oct.1888, *C. French s.n.* (MEL, P); Lake Albacutya, Sep. 1897, *C. French s.n.* (MEL, P); *s. loc.*, Dec. 1853, *J. Mueller s.n.* (MEL); Wimmera [River], *s. dat.*, *Anonymous* 18 (MEL); Dandenong Range, *s. dat.*, *s. leg.* (MEL). NEW SOUTH WALES: Tooma Rapids, *s. dat.*, *[Miss] Campbell s.n.* (MEL); Barrier Range, June 1889, *J.F. Irvine s.n.* (MEL); Wagga, 1886, *R. Thom s.n.* (MEL); Darling River, 1889, *[Miss] Urquhart s.n.* (MEL); Castlereagh [River], *s. dat. W. Woolls s.n.* (MEL).

Habitat. In open woodlands and forest, on dunes, flats and valley floors, in sandy and loamy soils, often over limestone.

Distribution. Widespread across southern Australia, occurring in the Avon Wheatbelt region in the South-west Botanical Province, and the Murchison, Coolgardie, Great Victoria Desert, Nullarbor and Hampton Bioregions in the Eremaean Botanical Province of Western Australia; the Great Victoria Desert, Nullarbor, Gawler, Eyre York Block, and Flinders Lofty Block Bioregions of South Australia; Broken Hill Complex, Mulga Lands, Darling Riverine Plain, Brigalow Belt South, Cobar Peneplain, Riverina, South Western Slopes, and South Eastern Highlands Bioregions of New South Wales; and the Murray Darling Depression, Victorian Midlands and South Eastern Highlands Bioregions of Victoria (Figure 1).

Affinities. The densely lanate vestiture on the vegetative parts of *Olearia incana* is typical of *Olearia* sect. *Eriotriche* where this species would seem best retained. Its affinities appear to lie with *O. pimeleoides* (DC.) Benth. *sens. str.*, from which it is readily distinguished: the leaves of *O. pimeleoides* are discolorous, subglabrous and green adaxially, grey-woolly hairy abaxially; its heads are solitary or in loose panicles; its achenes are obovoid; and its pappus is comprised of 39–65 bristles.

Typification. The combination *Olearia incana* Lander (1992: 192 & figure) was invalid under ICBN Article 33.3 since there is no direct reference to the author of its basionym and the place of valid publication with page or plate reference and date. This oversight is corrected here.

A single specimen of this taxon collected at Coolgardie by C.A. Gardner (PERTH 0052966) was labelled '*Olearia lanatus* auct.' by [W.R.] Phillipson in 1938, which suggests that the W.A. taxon may have been recognised as a species at that time in Western Australia. Phillipson (a New Zealand professor of botany) appears to have coined a number of species names in this way. The name *Olearia lanata* was published formally by Josephine Koster (1966: 536–537), who applied it to a New Guinea species.

Notes. Cooke (1985: 181) notes that '[*Olearia pimeleoides*] subsp. *incana* appears to be parapatric with the typical subspecies at the south-eastern edge of its range, which is almost entirely through more arid habitats than the range of subsp. *pimeleoides*.' However, mapping the occurrence of the 108 collections of *O. incana* and 815 specimens of *O. pimeleoides sens. str.* examined in the course of this study (Figure 1) shows them in fact to be very broadly overlapping over much of southern Australia. Furthermore, unlike that of *O. incana*, the distribution of *O. pimeleoides sens strict.* is strikingly disjunct for it is absent entirely in the Great Victoria Desert and Nullarbor Plain Bioregions.

Although the morphological differences between *Olearia incana* and *O. pimeleoides* are seemingly not great they are maintained in a wide range of habitats over an enormous geographical area. Thus both taxa are recognised here as species.

Conservation status. This species is very widely distributed and is neither rare nor endangered.

Etymology. From the Latin *incanus*, referring to the greyish foliage of this species.

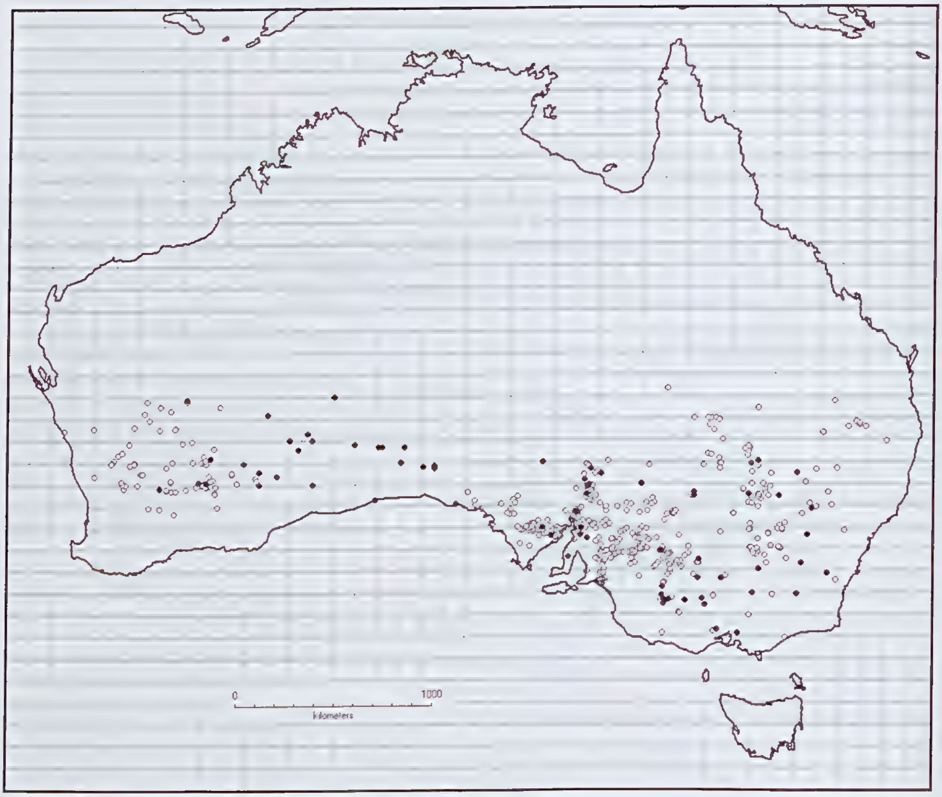

Figure 1. Distribution of *Olearia incana* (•) and *O. pimeleoides* (o).

Olearia newbeyi Lander, *sp. nov.*

Oleariae stuartii affinis sed capitulis flosculis radii 76–85 in 3–4 seriebus, non 21–64 in serie singulari, et 6–11 (non 20–72) flosculis disci, antheris 0.83–0.93 (non 1.6–3.3) mm longis, acheniis 0.6–1.1 (non 2.0–2.3) mm longis, et setis pappi longitudine flosculos disci paulo superantibus (non sub-aequalibus) differt.

Typus: [locality withheld for conservation reasons], 21 January 1985, *K.R. Newbey* 10897 (*holo*: PERTH 06105424 – 3 sheets).

Shrub to 0.3 m high × 0.30–0.35 m wide. Vegetative parts sparsely hairy with biseriate, capitate, glandular trichomes. Stems ascending to erect; bark smooth, minutely multi-ribbed, pale brown to green, otherwise purple. *Leaves* appressed, sessile, clasping, crowded in fascicles, becoming scattered and alternate as the branches extend, slightly conduplicate. Lamina flat, 2–12 mm long × 0.8–4.0 mm wide, broadly linear to narrowly oblong, smooth, concolorous, dull medium-green; midvein distinct; vestiture uniform, sparsely glandular with long thin and short broad, capitate, glandular trichomes; texture fleshy to herbaceous; base shallowly cordate; margin variably serrate; apex acute. *Heads* terminal, in paniculate conflorescences, 5–8 mm in diameter, pedunculate, minutely radiate; peduncle 2–20 mm long × 0.2–0.4 mm wide; bracts several, grading into those of the involucre; involucre cup-shaped; bracts 4-seriate, flat, 1.7–4.7 mm long × 0.4–0.8 mm wide, glandular with long thin and short broad, biseriate, capitate trichomes and occasional biseriate, simple, glandular trichomes; apex narrowly acute; margin membranous, ciliate. *Outer involucral bracts* narrowly triangular, dark to pale green, purple apically; abaxial surface uniformly sparsely glandular; adaxial surface sparsely glandular apically, otherwise glabrous. *Inner involucral bracts* narrowly linear to triangular, dark yellow or purple, sparsely glandular apically to centrally, subglabrous basally. *Receptacle* slightly concave or flat. *Ray florets* 76–85, female, 3–4-seriate, 1.9–3.7 mm long, dull medium purple. Staminodes absent. Floral tube sparsely hairy apically with biseriate, simple, eglandular trichomes. *Ligule* elliptic, linear or oblong, 1.5–2.0 mm long × 0.16–0.33 mm wide, sparsely hairy basally; apex 2–3-lobed. *Stylar arms* 0.5–1.0 mm long × 0.1 mm wide, narrowly filiform, the stigmatic area limited to the apical region. *Disc florets* 6–11, bisexual, 2.3–2.9 mm long, buccinate, sparsely hairy apically and centrally with biseriate, simple, eglandular trichomes; lobes 5–6, 0.40–0.56 mm long, acute. *Anthers* 0.83–0.93 mm long, narrowly acute; lobes fused to filament collar; sterile appendage narrowly to very narrowly ovate; filament collar 0.16–0.26 mm long. *Stylar arms* 0.50–0.96 mm long × 0.10–0.13 mm wide; sterile appendage half-clavate, with botuliform sweeping-hairs. *Achenes* 0.6–1.1 mm long × 0.2–0.3 mm wide, narrowly to very narrowly ellipsoid to obovoid, pale brown, uniformly densely hairy with duplex and glandular hairs; venation indistinct; base truncate; carpopodium conspicuous, central or oblique; apex truncate. *Pappus* uniseriate with 18–30 barbellate bristles, slightly longer than the tubular florets. (Figure 2)

Flowering period. January.

Habitat. On disturbed roadside in shrubland in loamy sand over a granite apron.

Distribution. Known from a single population in the Mallee Bioregion of the South-west Botanical Province of Western Australia. (Figure 3)

Affinities. The sparsely glandular-hairy vestiture on vegetative surfaces of *Olearia newbeyi* is typical of *Olearia* sect. *Merismotriche* Archer ex Benth., where this species would seem best placed. Its affinities may lie with *O. stuartii* (F.Muell.) F.Muell. ex Benth., from which it is readily distinguished: the capitula of *O. stuartii* have 21–64 ray florets in a single series and 20–72 disc florets, its anthers are 1.6–3.3 mm long, and its achenes are 2.0–2.3 mm long with a pappus of bristles subequal to the disc florets.

Conservation status. Further investigation is required for an accurate assessment of the conservation status of this species; therefore it is currently classified as category 1K of Briggs and Leigh (1996) and as Priority One of the Western Australian Flora Conservation Codes adopted by the Department of Environment and Conservation (DEC).

Etymology. The specific epithet refers to the collector of this species, farmer and botanist Ken Newbey (1936–1988) of Ongerup, Western Australia (Kenneally 1988).

Olearia trifurcata Lander, *sp. nov.*

Oleariae passerinoides affinis sed ramificatione trifurcata non divaricata, foliis in sectione transversali anguste triangularibus non teretibus, capitulis flosculi radii 2–4 non 6–16, flosculis disci 3, non 14, et acheniis setis pappi 40–52 non 25–40, differt.

Typus: *c.* 1 km SE of Kau Rock, 33 ° 24' 35" S, 122° 19' 53" E, *c.* 60 km NE of Esperance, 13 January 1990, *W. Archer s.n.* (*holo*: PERTH 1292471; *iso*: AD, CHR, K, MEL).

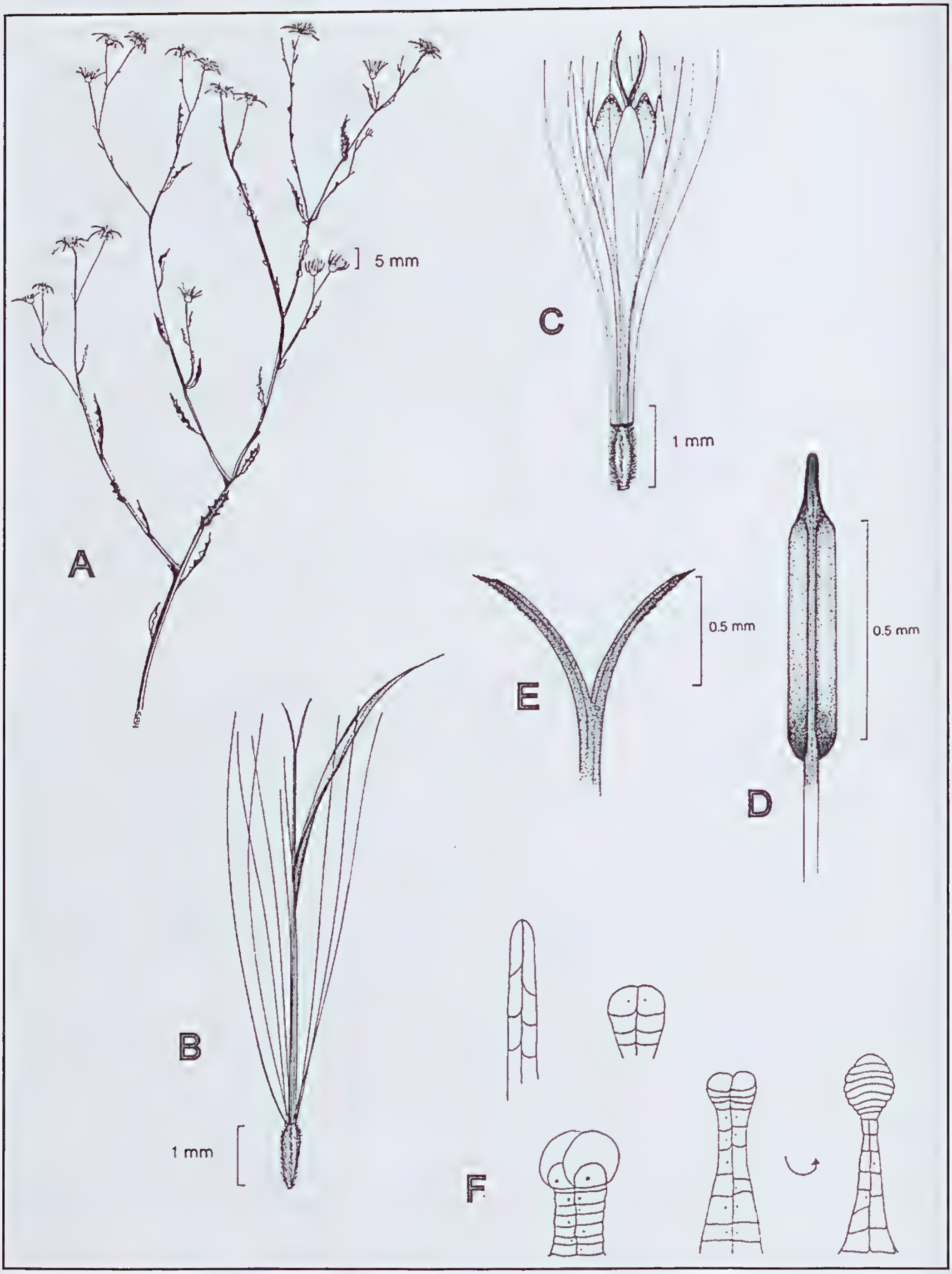

Figure 2. *Olearia newbeyi*. A – habit; B – ray floret; C – disc floret; D – anther; E – stylar arms; F – trichomes. Drawn from *K. Newbey* 10897 (*holo*: PERTH 06105424).

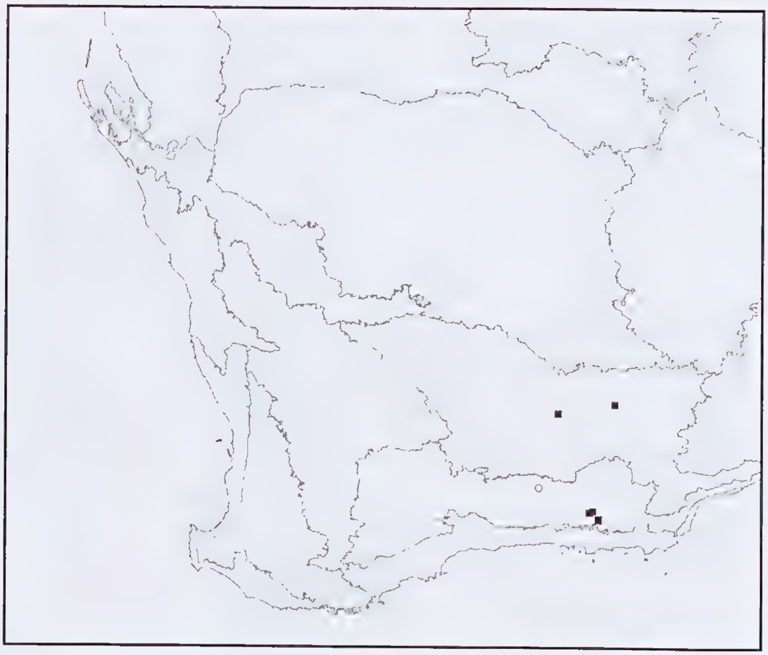

Figure 3. Distribution of *Olearia newbeyi* (o) and *O. trifurcata* (■).

Subshrub, dense, upright, tussock-like, to 0.3 m high × 0.4 mm wide; vegetative surfaces pustulate and viscid, but otherwise glabrous. Stems trifurcate, pale green. *Leaves* opposite, sessile. *Lamina* very narrowly triangular, 1.2–8.0 mm long × 0.8–1.0 mm wide, conduplicate, pale green, pustulate and viscid, indurate; base somewhat dilated; margin entire; apex acuminate, somewhat recurved, mucronulate. *Heads* solitary, terminal, sessile, radiate, 8–12 mm in diameter; disc 2.5–5.0 mm in diameter. Involucre narrowly obconic or ovoid; bracts 4–5-seriate, 0.9–7.7 long × 0.5–2.2 mm wide. *Outer involucral bracts* triangular, carinate; stereome green, pustulate, viscid; margin narrowly membranous, irregularly serrulate; apex acute. *Inner involucral bracts* narrowly elliptic, carinate; stereome pale and smooth basally, green and pustular apically; margin narrowly membranous, irregularly serrulate; apex acute. *Receptacle* slightly convex. *Ray florets* 2–4, uniseriate, radiate, female; corolla 7.5–8.0 mm long, white. Staminodes absent. Floral tube 3.2–3.6 mm long, with scattered biseriate, eglandular hairs. *Ligule* broadly elliptic or obovate, 4.8–5.0 mm long × 2.5–2.6 mm wide, minutely 3-lobed apically. *Stylar arms* filiform, 1.1–1.5 mm long, minutely papillose abaxially. *Disc florets* 3, bisexual; corolla cylindric, 5.0–5.7 mm long, pale yellow; tube 4.1–4.2 mm long, with biseriate, eglandular hairs scattered basally; lobes narrowly triangular, 1.0–1.5 mm long. *Anthers* 1.9–2.0 mm long; apical appendages elliptic; basal lobes acute and shorter than the filament collar; filament collar 0.5–1.0 mm long; filaments attached 1.5 mm from base of tube. *Stylar arms* filiform, 1.9–2.4 mm long × 0.5–0.6 mm wide, with narrowly triangular apical appendages bearing minutely botuliform papillae above the stigmatic lines. *Achene* obovoid, 1.7–2.3 mm long × 1.0–1.3 mm wide, pale brown, sericeous with long, duplex hairs; base acute; carpopodium, inconspicuous, central; apex truncate. *Pappus* uniseriate with 40–52 minutely barbellate bristles, more or less equal to the tubular florets. (Figure 4)

Flowering period. January to February.

Other specimens examined. WESTERN AUSTRALIA: *c.* 1 km SE of Kau Rock, *c.* 60 km NE of Esperance, 3 Feb. 1990, *W. Archer s.n.* (PERTH 1216724); 1 km NE of Kau Rock, *c.* 65 km NE of

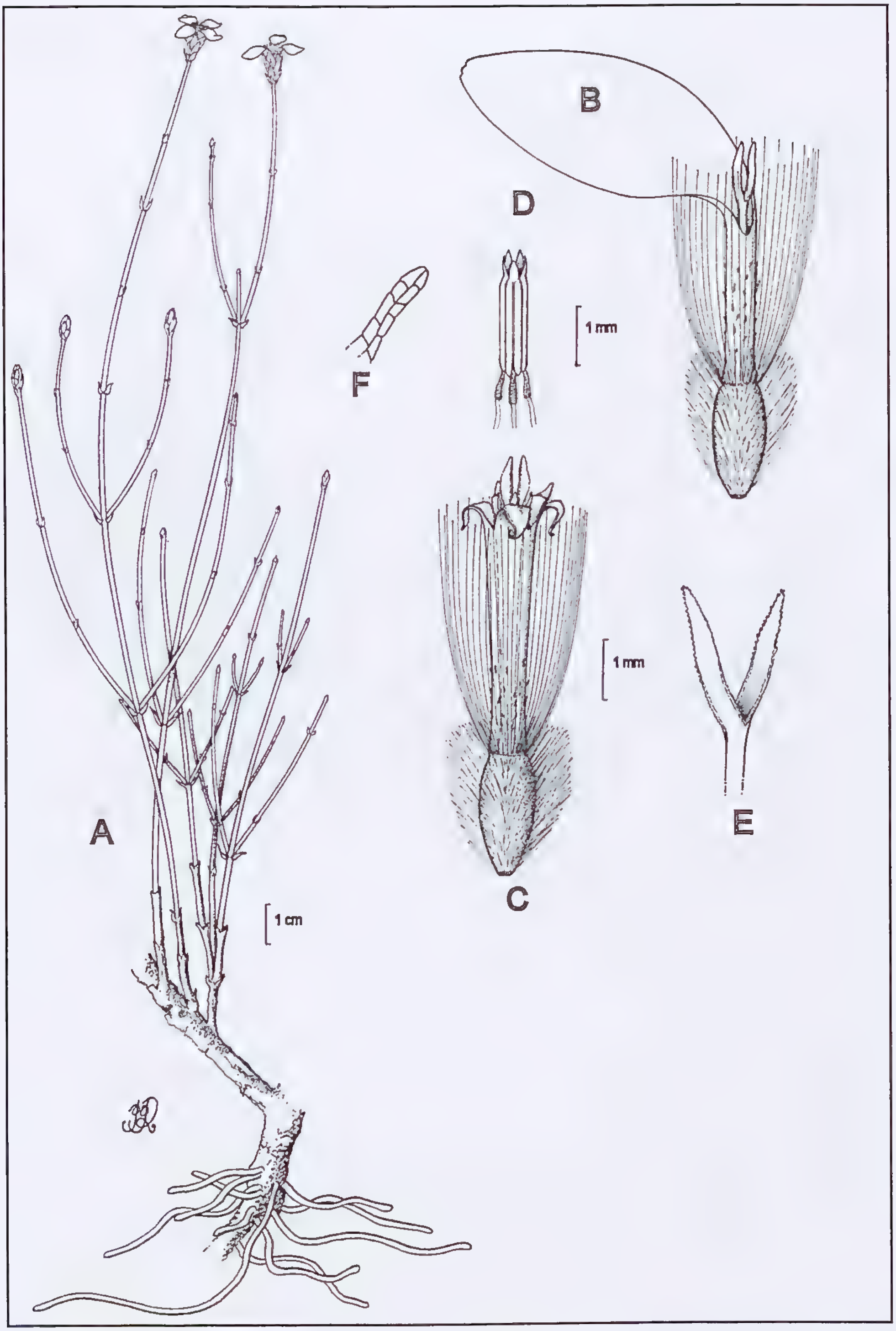

Figure 4. *Olearia trifurcata*. A – habit; B – ray floret; C – disc floret; D – anthers; E – stylar arms; F – trichome. Drawn from *W. Archer s.n.* (*holo*: PERTH 1292471).

Esperance, 7 Jan. 1996, *W. Archer* 701961 (PERTH 05423368); 11 km ENE of Mt Ridley, 10 Feb. 1990, *W. Archer* 1002902 (PERTH 1215752); island in SE portion of Lake Halbert, 17 Feb. 1990, *W. Archer* 1702904 (PERTH 1215760); NW shore of Lake Halbert, 5 km ENE of Mt Ridley, 24 Feb. 1990, *W. Archer* 2402901 (PERTH 1216716); N shore of Lake Halbert, 6.5 km ENE of Mt Ridley, 24 Feb. 1990, *W. Archer* 2402902 (PERTH 1215744); SW shore of Lake Halbert (0.5 km SSW of 2402901), 24 Feb. 1990, *W. Archer* 2402903 (PERTH 1231472); 93 km ESE of Kambalda, 31 Mar. 1997, *W. Archer* 3103971 (PERTH); 2 km SE of Widgiemooltha, 18 Aug. 1981, *K.R. Newbey* 8559 (PERTH 1679341); 2 km SE of Widgiemooltha, 22 Jan. 1985, *K.R. Newbey* 10887 (AD, BRI, HO, MEL, NSW, NT, PERTH 2391503 & 1280031).

Distribution. Known from the Mallee Bioregion of the South-West Botanical Province of Western Australia where it occurs over an area of some six hectares around Lake Halbert and several other salt lakes in the vicinity, and from the Coolgardie Bioregion of the Eremaean Botanical Province of Western Australia where it occurs around a salt lake immediately south-east of Widgiemooltha, and on a rocky alluvial slope from a sandstone outcrop above a playa lake (Figure 3).

Habitat. Playa lake margins in sub-saline, sandy loam amongst halophytic low shrubland in the *Stipa* zone, 0.3–1.0 m above water level.

It has been suggested that the Kau Rock site may be influenced by the presence of gypsum (W. Archer, pers comm.). If so, this species might be added to the list of gypsophiles found in Australia noted by Parsons (1976). The recently described *Olearia arckaringensis* Lang is also gypsophilous (Lang, in press).

Affinities. The pustulate, viscid vegetative surfaces of *Olearia trifurcata* are typical of *Olearia* sect. *Merismotriche* Archer ex Benth., where this species would seem best placed. Its affinities may lie with *O. passerinoides* (Turcz.) Benth., from which it is readily distinguished: the stems of *O. passerinoides* are divaricately branched; its leaves are compressed-terete and slightly concave above; its ray florets are 6–15; its disc florets are 10–14 and are mauve to pink; its pappus bristles are 25–40. *O. passerinoides* is widespread in Victoria, South Australia and Western Australia.

Notes. The underground branching radiates like the spokes of a wheel, equally from the centre of the plant. The unusually thick, unbranching, hairy roots spread horizontally (far in excess of the foliage) and are contained within the top 50 mm of soil where the pH is neutral: the compacted soil beneath is alkaline with a pH of 8.5 (W. Archer, pers. comm.)

The trifurcate branching observed in this taxon is remarkable and has been observed in no other species of *Olearia*.

Conservation status. This species is confined to a single habitat type and has a restricted distribution with a geographic range of less than 250 km. However, it is estimated that there are some 7000 individuals at sites in the Lake Halbert area alone (W. Archer, pers. comm.) and 1000 individuals at the Kambalda site (W. Archer, pers. comm.), and it is also common at the Widgiemooltha site (K.R. Newbey, pers. comm.). Currently, it appears to be neither endangered nor vulnerable.

Etymology. The specific epithet refers to the unusual branching characteristic of this species.

Acknowledgements

I am indebted to the late Mr Kenneth R. Newbey of Ongerup for first drawing two of these species to my attention, and to Mr William Archer of WA Nurseries, Mt Merivale, for his exhaustive search for further populations of *Olearia trifurcata* and for his detailed field observations. I am grateful to Ms Susan Harris for the illustration of *O. newbeyi* and to Mr John J. Rainbird for the illustration of *O. trifurcata.* Mr Paul Wilson provided the Latin diagnoses and offered a number of useful comments on a draft of this paper. I thank the following herbaria for access to and/or the loan of specimens from their collections: AD, AK, BH, BM, BRI, CANB, CBG, CGE, CHR, CO, DBN, ED, FL, G, HO, K KPBG, L, LD, MEL, NSW, P, TCD, and WRSL.

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A review of *Acacia coolgardiensis* (Leguminosae: Mimosoideae) and closely related species in Western Australia

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Abstract

Maslin, B.R. & Buscumb, C. A review of *Acacia coolgardiensis* (Leguminosae: Mimosoideae) and closely related species in Western Australia. *Nuytsia* 18:107–125 (2008). The three subspecies formerly comprising the widespread, variable, Western Australian species *Acacia coolgardiensis* Maiden are now treated as distinct species, namely, *A. coolgardiensis*, *A. effusifolia* Maslin & Buscumb (syn. *A. coolgardiensis* subsp. *effusa* R.S.Cowan & Maslin) and *A. latior* (R.S.Cowan & Maslin) Maslin & Buscumb (syn. *A. coolgardiensis* subsp. *latior* R.S.Cowan & Maslin). Two new related species are also described, *A. incognita* Maslin & Buscumb which was formerly confounded with *A. coolgardiensis* subsp. *coolgardiensis*, and the recently discovered *A. sulcaticaulis* Maslin & Buscumb which is listed as a Priority One species according to the Department of Environment and Conservation's (DEC) Conservation Codes for Western Australian Flora. A key to the recognition of these five species is presented.

Introduction

Acacia coolgardiensis Maiden was defined by Cowan and Maslin (1995) as a wide-ranging, variable species comprising three subspecies, subsp. *coolgardiensis*, subsp. *effusa* R.S.Cowan & Maslin and subsp. *latior* R.S.Cowan & Maslin. It was recognised at the time that this was a conservative classification and that future study may necessitate the species being further divided or the subspecies being treated as distinct species.

The impetus that led to the present study of *A. coolgardiensis* was the need to assess the taxonomic and conservation status of three clearly allied entities which occur on or near mining leases on Karara and Warriedar Stations, about 100 km east of Morawa. In order to properly understand these entities it was necessary to examine *A. coolgardiensis* over its geographic and morphological ranges, therefore the opportunity has been taken to briefly review the entire species complex. Two of the entities referred to above are described below as the new species, *A. incognita* Maslin & Buscumb and *A. sulcaticaulis* Maslin & Buscumb, while the third is regarded as a narrow-phyllode morph of what was formerly called *A. coolgardiensis* subsp. *latior*. As to the previously-defined *A. coolgardiensis* (which is referred to below as *A. coolgardiensis sens. lat.*) it is now considered more appropriate that the three subspecies be treated as distinct species, *A. coolgardiensis*, *A. effusifolia* Maslin & Buscumb (syn. *A. coolgardiensis* subsp. *effusa* R.S. Cowan & Maslin and *A. latior* (R.S.Cowan & Maslin) Maslin & Buscumb (syn. *A. coolgardiensis* subsp. *latior*).

As discussed below *A. incognita* and *A. sulcaticaulis* share a number of important taxonomic characters with *A. coolgardiensis sens. lat.*, especially their phyllode nervature, head shape, calyx division and carpological features. However, to have included them as subspecies within an already broadly circumscribed *A. coolgardiensis sens. lat.* would have expanded the definition of the species to the extent that its concept would become somewhat meaningless. The decision to treat *A. incognita* and *A. sulcaticaulis* as distinct species led naturally to a reconsideration of the rank applied to the three subspecies comprising *A. coolgardiensis sens. lat.*

When Cowan & Maslin (1995: 19) recognised these taxa as subspecies they noted that this was a conservative classification and that the criteria used for applying rank was determined subjectively. Admittedly, our decision here to treat these taxa as species is also a subjective one but the taxa do represent robust biological entities and each exhibits geographic integrity. This action was an attempt to establish comparability of rank between taxa of the '*A. coolgardiensis* group'. Much of the significant variation found among members of this group is in the vegetative system, especially phyllode shape and size, new shoot indumentum and resinosity, and branchlet resinosity, but there are also differences in the inflorescences (especially head shape and peduncle length), pods and seeds (especially length). While most specimens can confidently be assigned to a species on the basis of morphological criteria there are a few that cannot be placed with certainty. This does not negate our decision to recognise distinct species but seems more likely to reflect the inherent variable nature of the taxa and our lack of opportunity to thoroughly elucidate this variation, including the investigation of putative hybridity. However, it is anticipated that, by emphasising the differences between the taxa by treating them as species, additional characters will be revealed in time that will further support their recognition. Treating them as subspecies focuses on the similarities between the taxa, thus reducing the impetus to look for further distinguishing features. Future study of these species may well benefit from the use of genetic markers and a more thorough study of populations in the field than we have been able to do.

The five species included in this paper are here referred to the informal '*A. coolgardiensis* group' and a key to their recognition is given below. The more important morphological characters that define this group include the following: fluted stems (*A. incognita* excepted), multi-nerved phyllodes, flowers aggregated into obloid (rarely globular) heads to short-cylindrical spikes on short peduncles, free or variably united sepals, terete, narrow, relatively thin-textured, obscurely longitudinally nerved pods, and longitudinally orientated, obloid, white-arillate seeds. Species related to those of the '*A. coolgardiensis* group' include *A. thoma* Maslin, *A. balsamea* R.S.Cowan & Maslin, *A. cockertoniana* Maslin and *A. resinosa* Maslin; the Mulga group (*A. aneura* F.Muell. ex Benth. and relatives) is not far removed.

Images of all species described in this paper are on the WorldWideWattle website (http://www.worldwidewattle.com) and their distributions are shown on the FloraBase website (http://florabase.dec.wa.gov.au/).

Taxonomy

Key to species of the '*Acacia coolgardiensis* group'

1. Phyllodes terete, rarely subterete **2**

1: Phyllodes flat **3**

2. Peduncles stout and normally 0.5–2 mm long and obscured by the stamens at anthesis (so heads appear sessile). Heads mostly obloid to short-cylindrical and paired within phyllode axil. Ribs at extremities of branchlets often with thick overburden of resin. Stems longitudinally fluted (flutings sometimes obscure). Bark smooth (ignore extreme base of stems) .... **A. coolgardiensis**

2: Peduncles slender and normally 4–6 mm long and clearly visible when the heads are at anthesis. Heads mostly globular to short-obloid and single within phyllode axil. Ribs at extremities of branchlets without thick overburden of resin. Stems not longitudinally fluted. Bark fissured .... **A. incognita**

3. Phyllodes some or all 5 mm wide or wider **4**

3: Phyllodes all less than 5 mm wide **5**

4. Phyllodes bright green, glabrous or very indistinctly hairy. Branchlet apices clearly flattened. Pods less than 2 mm wide .... **A. sulcaticaulis**

4: Phyllodes silvery grey-green due to a dense indumentum (especially evident on young and adolescent phyllodes). Branchlet apices not clearly flattened. Pods 2–3 mm wide .... **A. latior**

5. Heads mostly single within axil of phyllodes, globular to short-obloid. Peduncles ± glabrous, visible below anthers at anthesis. Phyllodes 1–1.5 mm wide, green. New shoots and phyllodes glabrous or sub-glabrous. Branchlets not resin-ribbed. Stems (mature plants) not longitudinally fluted. .... **A. incognita**

5: Heads mostly paired within axil of phyllodes, short-obloid to cylindrical. Peduncles moderately to densely hairy (indumentum sometimes obscured by resin), sometimes obscured by anthers at anthesis. Phyllodes 1–4 mm wide, silvery green or grey-green to sub-glaucous. Stems (mature plants) ?always sparingly longitudinally fluted **6**

6. New shoots conspicuously hairy. Phyllodes with a distinct silvery sheen due to indumentum which covers the lamina of young and adolescent phyllodes. Branchlet ribs not resinous .... **A. latior**

6: New shoots not conspicuously hairy, encrusted by conspicuous resin (drying dark coloured) when initiated. Phyllodes not as above (the hairs less conspicuous and confined to between the longitudinal nerves). Branchlet ribs (at extremities of branchlets) often coated with an overburden of resin .... **A. effusifolia**

Acacia coolgardiensis Maiden, *J. & Proc. Roy. Soc. New South Wales* 53: 211, pl 15, figs 1–7 (1920). *Lecto* (*fide* Cowan & Maslin 1995: 18): Coolgardie, Western Australia, 26 August 1900, *L.C. Webster* (NSW); *isolecto*: K, PERTH 00745731. *Paralecto*: Coolgardie, Western Australia, 1899, *L.C. Webster* (NSW).

Acacia boorabbinensis Hochr., *Candollea* 2: 377 (1925). *Holo*: Boorabbin, Western Australia, 15 February 1905, *B.P.G. Hochreutiner* 2946 (G).

Multi-stemmed *shrubs* or *trees* 2–5(–7) m tall, stems with few to many, shallow to deep longitudinal flutings. *Bark* grey, smooth except finely longitudinally fissured at extreme base of stems on oldest plants. *Branchlets* silvery and minutely appressed-hairy between ribs, the ribs at ends of branchlets normally (but not always) with a thick, sometimes crenulated, overburden of resin. *New shoots* with a thick coating of resin when initiated, the branchlet and phyllode hairs becoming visible as the shoot expands, the expanding shoot sprinkled with reddish resin hairlets which are soon lost, viscid when fresh (not viscid when dry). *Phyllodes* terete, rarely sub-terete, (4–)6–11(–15) cm long, 0.6–0.8(–1) mm diam., filiform, erect, not rigid, sub-straight to shallowly incurved, grey-green or dull green, glabrous or minutely appressed-hairy between the nerves; *longitudinal nerves* numerous, fine, close together, sometimes with overburden of resin; *apex* acute, straight to uncinate, innocuous to coarsely pungent. *Gland* situated on upper edge of phyllode 0–1 mm above pulvinus. *Inflorescences* simple, mostly paired within axils of phyllodes; *heads* showy, obloid to short-cylindrical, sometimes globular, 5–9(–12) × (4–)5–6 mm when dry, golden, normally superficially sessile with the very short peduncles obscured by the stamens at anthesis; *peduncles* 0.5–2(–3) mm long, stout (0.7–1 mm diam. when dry), normally moderately to densely ± appressed-hairy with sparse (rarely dense) red-brown resin hairlets intermixed with the orthodox hairs, indumentum often sparser or absent when in pod; *receptacles* with sparse to dense red resin hairlets which are absent when in pod. *Flowers* 5-merous; *sepals* free to 1/2-united. *Pods* terete, straight-edged or very slightly constricted between the seeds, (2–)4–8(–10) cm long, 1–2 mm wide, thinly coriaceous-crustaceous, straight to shallowly curved, glabrous or with minute, silvery, appressed hairs between the often obscure (not raised) longitudinal nerves, resinous (but not viscid), reddish brown. *Seeds* longitudinal in the pod, 2.5–4 mm long, 1–1.5 mm wide, obloid, shiny, normally tan; *aril* terminal and creamy white.

Characteristic features. Multi-stemmed *shrubs* or *trees* 2–5(–7) m tall, stems with few to many, shallow to deep longitudinal flutings. *Bark* smooth except finely longitudinally fissured at extreme base of stems on oldest plants. *Branchlets* hoary between ribs which normally have an overburden of resin. *New shoots* resin-encrusted, the expanding shoots sprinkled with reddish resin hairlets. *Phyllodes* terete, rarely sub-terete, (4–)6–11(–15) cm long, 0.6–0.8(–1) mm diam., filiform, not rigid, grey-green or dull green; *longitudinal nerves* numerous, fine, sometimes with overburden of resin; *apex* innocuous to coarsely pungent. *Inflorescences* mostly paired within axils of phyllodes; *heads* globular to obloid or short-cylindrical, 5–9(–12)×(4–)5–6 mm when dry, golden, normally appearing sessile with the very short peduncles obscured by the stamens at anthesis; *peduncles* 0.5–2(–3) mm long, stout, ± appressed-hairy with sparse (rarely dense) red-brown resin hairlets intermixed. *Flowers* 5-merous; *sepals* free to 1/2-united. *Pods* terete, 1–2 mm wide, thin-textured, ± obscurely longitudinally nerved. *Seeds* longitudinal in the pod; aril creamy white.

Selected specimens examined. WESTERN AUSTRALIA: Mullewa, 14 July 1971, *A.M. Ashby* 4252 (PERTH); 12 km E of Latham, 14 Aug. 1997, *F. Keast* L8C076 (PERTH); 3 miles [4.8 km] W of Bunjil on the road to Carnamah, 9 Aug. 1970, *B.R. Maslin* 739 (AD, BRI, K, PERTH); 4.5 miles [7.2 km] NW of Southern Cross towards Bullfinch, 12 Aug. 1971, *B.R. Maslin* 1954 (PERTH); 16 miles [25.7 km] SW of Kalgoorlie towards Coolgardie, 9 Aug. 1971, *B.R. Maslin* 1899 (HO, NY, PERTH); 51.5 miles [82.8 km] km S of Billabong Roadhouse on North West Coastal Highway [near southern boundary of Nerren Nerren Station], 16 June 1972, *B.R. Maslin* 2783 (BRI, PERTH); 23 km N of Murchison River on North West Coastal Highway, 21 Aug. 1973, *B.R. Maslin* 3338 (CANB, E, PERTH); near Modesty Downs Station, *c.* 21.5 km N of Holt Rock, 11 Oct. 1975, *B.R. Maslin* 3938 (PERTH); 45 km E of Mullewa towards Yalgoo, 31 Aug. 1976, *B.R. Maslin* 4263 (MEL, PERTH); 97.5 km NNE of Kalgoorlie on the road to Edjudina Station, 18 Feb. 1981, *B.R. Maslin* 4849 (PERTH); 2.1 km E of Kununoppin on the road to Nungarin, 1 Dec. 1982, *B.R. Maslin* 5319 (PERTH); 3.5 km E of Mullewa on road to Yalgoo, 3 Apr. 1992, *B.R. Maslin* 7114 (PERTH); about 45 km NE of Kalannie, Black Road, 9.5 km N of Glamoff Road intersection, 4 Dec. 1996, *B.R. Maslin* 7514 (PERTH); 55.5 km E of Mullewa on the road to Yalgoo, 25 Jan. 2008, *B.R. Maslin* 9417 (PERTH); 18 km NE of Wubin on Great Northern Highway to Paynes Find, 12 Oct. 1999, *B.R. Maslin & J. Miller* 7887 (PERTH); Boorabbin, *c.* 88 km E of Southern Cross, 20 Aug. 1979, *K. Newbey* 5719 (PERTH); Tallering Station [N of Pindar], 26 June 1993, *A. Payne* 3589 (NSW, PERTH); 7.9 km W of Broad Arrow on road to Ora Banda, Sep. 1979, *M.H. Simmons* 1176 (PERTH); base of Moorine Rock on Great Eastern Highway, Sep. 1979, *M.H. Simmons* 1238 (PERTH).

Distribution. Extends from near Nerren Nerren Station (*c.* 150 km north of Northampton) through the northern, north-eastern and north-central wheatbelt region (roughly Northampton to Mullewa, south to Koorda and east to Southern Cross) then east to the Coolgardie–Kalgoorlie region. It also occurs in the south-central wheatbelt near Holt Rock (*c.* 150 km south-east of Merredin) and extends to the south-west extremity of the arid zone in a few places, especially around Kalgoorlie. Cowan & Maslin (1995: 19, 20) and Cowan (2001: 329) refer to collections from Carey Downs, Byro and Curbur Stations: these are now provisionally referred to *A. incognita* (see below).

Habitat. In the agricultural zone *A. coolgardiensis* favours light, free-draining soils (light brown or yellow-brown, often gravelly, sandy loams) often in sandplain scrub and around granite rocks, whereas at the extremity of its range (e.g. the Kalgoorlie district) it occurs on heavier red-brown loam soils.

Flowering and fruiting period. Flowers from July to September, occasionally extending to early October. Peak flowering occurs in September while plants in July and August may be in bud or at anthesis. Pods with mature seeds occur from late October to January, occasionally persisting to February.

Conservation status. Not considered rare or endangered.

Etymology. The botanical name is based on the Western Australian goldfields township of Coolgardie which is located near the eastern extremity of the species' geographic range. The lectotype collection of the species was gathered from Coolgardie in 1900 by L.C. Webster (see Cowan & Maslin 1995: 19 for notes).

Common name. Sugar Brother.

Affinities. *Acacia coolgardiensis* is most closely related to *A. effusifolia* and is also related to *A. incognita* (see below under these species for discussion). The variant with fibrous bark referred to under *A. coolgardiensis* subsp. *coolgardiensis* by Cowan and Maslin (1995: 21) and represented by the specimen *B.R. Maslin* 4262 is *A. incognita*. The *B.R. Maslin* 4503 referred to in the same place is *A. coolgardiensis*.

Variation. *Acacia coolgardiensis* is typically characterised by its superficially sessile pair of heads within the axils of the phyllodes. These heads are in fact short-pedunculate (peduncles 0.5–2 mm long) but the peduncles are obscured by the stamens at anthesis. Occasionally, however, the peduncles are slightly longer (to 3 mm) and are visible below the stamens at anthesis. There is no taxonomic significance to this peduncle length variation.

Acacia effusifolia Maslin & Buscumb, *stat. et nom. nov.*

Base name: *Acacia coolgardiensis* subsp. *effusa* R.S.Cowan & Maslin, *Nuytsia* 10: 21 (1995). (*Type*: 17.5 km SE of Mullewa towards Morawa, Western Australia, 22 August 1973, *B.R. Maslin* 3356 (*holo*: PERTH 00718580; *iso*: CANB, K).

Shrubs or *trees* 2–5 m tall, single-stemmed or more commonly dividing at ground level into 2–6 main stems; *stems* of mature plants with few to many, shallow to deep, longitudinal flutings (needs confirmation – see *Notes* below), seemingly not fluted on young plants. *Bark* grey, smooth except finely longitudinally fissured at extreme base of stems on oldest plants (needs confirmation – see *Notes* below). *Branchlets* silvery and minutely appressed-hairy between ± obscure ribs, the ribs at ends of branchlets normally (but not always) with a thick, sometimes crenulated, overburden of resin. *New shoots* coated by resin when initiated, not viscid when dry, the expanding shoot sprinkled with red-brown resin hairlets which are soon lost. *Phyllodes* narrowly linear, narrowed at base, (4–)6–10(–14) cm long, (1–)1.5–3(–4) mm wide, sub-rigid, straight to shallowly incurved or shallowly recurved, sometimes resinous with a thin veneer of resin over entire surface (or occasionally confined to the nerves), variable in colour but commonly grey-green to sub-glaucous (ranging from green through grey-green to sub-glaucous or glaucous), with minute, appressed silvery hairs between the nerves, the oldest phyllodes sometimes glabrous; *longitudinal nerves* numerous and close together; *apex* acute, coarsely pungent to innocuous, straight to slightly curved, occasionally sub-uncinate. *Gland* situated on upper margin of phyllode 0–1 mm above pulvinus. *Inflorescences* simple, mostly paired within axils of phyllodes, appearing superficially sessile when peduncles are very short and obscured by the stamens at anthesis; *heads* showy, short-obloid to cylindrical, 5–15(–20) × 4–7 mm when dry; *peduncles* 1–6(–8) mm long, ± densely appressed-hairy (indumentum often obscured by resin) with sparse (sometimes dense) dark red-brown resin hairlets which persist to the fruiting phase; *receptacles* glabrous to sparsely hairy, occasionally intermixed with sparse red resin hairlets. *Flowers* 5-merous; *sepals* 1/2–2/3 length of petals, free or sometimes variably united for about 1/4 their length, narrowly oblong to spathulate; *petals* 1.5–2.2 mm long. *Pods* terete, straight-edged or more commonly very slightly constricted between the seeds, (2–)3–7(–9) cm long, 1–2 mm wide, thinly coriaceous-crustaceous to firmly chartaceous, straight to shallowly curved, glabrous or with minute, silvery appressed hairs between the often obscure (not raised) longitudinal nerves, resinous (but not viscid), brown to reddish brown. *Seeds* longitudinal in the pod, 3–4 mm long, *c.* 1 mm wide, obloid, shiny, brown; *aril* 1/3–1/2 as long as seed, terminal, fleshy, white.

Characteristic features. *Shrubs* or *trees* with presumably fluted stems and smooth bark. *Branchlets* hoary between ribs which normally have an overburden of resin. *New shoots* resin-encrusted, the expanding shoots sprinkled with reddish resin hairlets. *Phyllodes* narrowly linear, (4–)6–10(–14) cm long, (1–)1.5–3(–4) mm wide, sub-rigid, straight to shallowly curved, commonly grey-green to sub-glaucous, minutely silvery appressed-hairy between the numerous longitudinal nerves. *Inflorescences* mostly paired within axils of phyllodes, appearing sessile when peduncles very short; *heads* short-obloid to cylindrical, 5–15(–20) × 4–7 mm when dry; *peduncles* 1–6(–8) mm long, ± densely appressed hairy with sparse (sometimes dense) red-brown resin hairlets intermixed. *Flowers* 5-merous; *sepals* 1/2–2/3 length of petals, free or sometimes variably united for about 1/4 their length. *Pods* terete, 1–2 mm wide, thin-textured, ± obscurely longitudinally nerved. *Seeds* longitudinal in the pod; *aril* white.

Selected specimens examined. WESTERN AUSTRALIA: between Davyhurst and Goongarrie, 10 Sep. 1970, *J.S. Beard* 6259 (PERTH); Karara Station, 28 Oct. 1974, *J.S. Beard* 7196 (PERTH); Mt Farmer Station, 12 Aug. 1987, *P.J. Curry* 1047 (CANB, PERTH); Hill View Station, No. 1 Fence, 15 Aug. 1959, *S.J.J. Davies s.n.* (PERTH 06012795); 24 km ENE of Yuinmery Homestead, 18 Sep. 1986, *J. Dell* JD158 (PERTH); on Rabbit Proof Fence running E-W, S boundary of Running Water Paddock, Woolgorong Station, N of Mullewa, 25 May 2006, *D.J. Edinger* 5868 (PERTH); 45 km N of Cleary on road to Paynes Find, 9 Sep. 1987, *J.W. Green* 5235 (PERTH); 52.4 km from Wubin towards Mount Magnet, 28 July 1974, *B.R. Maslin* 3539 (CANB, PERTH – phyllodes narrower than normal); 96.5 km from Wubin towards Mount Magnet, 27 July 1974, *B.R. Maslin* 3548 (MEL, PERTH); 29 km W of Yalgoo towards Mullewa, 1 Aug. 1975, *B.R. Maslin* 3622 (BM, BRI, G, K, MEL, NSW, NY, PERTH); 22.5 km S of Billabong Roadhouse towards Geraldton [Northwest Coastal Highway, on Nerren Nerren Station], 8 Aug. 1974, *B.R. Maslin* 3718 (MEL, PERTH); 73.5 km S of Mount Magnet on Great Northern Highway to Wubin, 21 Aug. 1985, *B.R. Maslin* 4515 (PERTH); about 50 km due NE of Kalannie, W side of Lake Moore (Hudson's farm), 9 Sep. 1997, *B.R. Maslin* 7764 (PERTH); NW end of Jackson Range, W of Bullfinch – Menzies Road near Portman Mining site, 30 Sep. 2004, *B.R. Maslin* 8608 (PERTH – phyllodes narrower than normal); 2 km due W of Windarling Range (between Bullfinch and Menzies), 30 Sep. 2004, *B.R. Maslin* 8612 (PERTH); 21.5 km N of Sandstone on road to Meekatharra, 4 Sep. 2006, *B.R. Maslin* 8958 (PERTH); 55.5 km E of Mullewa on the road to Yalgoo, 25 Jan. 2008, *B.R. Maslin* 9418 (PERTH); Gabyon Station [*c.* 40 km WNW of Yalgoo – phyllodes atypically short], 2 Nov. 1981, *A.A. Mitchell* 914 (CANB, K, PERTH); Wiluna area, Dec. 1970, *J. Morrissey* 40 (PERTH); 19 miles [30.6 km] S of Menzies, 13 Sep. 1966, *K.R. Newbey* 2580 (PERTH – phyllodes atypically narrow); near Bimbijy [Station, *c.* 60 km SE of Paynes Find – phyllodes atypically short], 15 Sep. 1990, *S. Pignatti* 483 (PERTH); Leinster outside town, 27 Aug. 1998, *J.G. & M.H. Simmons* 3719 (PERTH); 40 km NE of Nambi HS which is *c.* 65 km NNE of Leonora, 29 Aug. 1968, *P.G. Wilson* 7477 (PERTH).

Distribution. Occurs in the south-west extremity of the arid zone in Western Australia, in the rangeland pastoral station country. It is found in an area bounded by Nerren Nerren Station (*c.* 150 km north of Northampton) south-east through Mullewa to near Kalannie and Cleary, east through Meekatharra to Wiluna then south to near Lake Goongarrie (north of Kalgoorlie). A specimen (*D.J. Pearson* 1780) in bud from Queen Victoria Spring (about 250 km E of Goongarrie) has provisionally been referred to *A. effusifolia*, however, better material is needed to confirm this identification. Cowan & Maslin (1995: 19, 22) and Cowan (2001: 329, 330) refer to an outlier from Paraburdoo−this is now *A. thoma* Maslin, see Maslin & van Leeuwen (2008).

Habitat. Acacia effusifolia grows in a variety of habitats but is commonly recorded from red sand or sandy loam (sometimes over hardpan) in 'Spinifex' (*Triodia* spp.) communities, or heavier-textured red or brown loam or clay-loam soil in *Eucalyptus* woodland. It also grows on sandplains in yellow sand in shrubland communities.

Flowering and fruiting period. Flowers from July to September or very occasionally mid-June. Plants in June and July are often only in bud. Herbarium records also show the species as occasionally flowering in December or March (presumably in response to the intermittent summer rainfall). Pods with mature seeds have been collected mostly in October and November, occasionally December.

Conservation status. Not considered rare or endangered.

Etymology. The specific epithet is derived from the Latin *effusus* (spread out, expanded) and *folius* (leaf) and refers to the flat phyllodes which distinguish the species from its closest relative, *A. coolgardiensis*, which has terete phyllodes.

Common name. None known.

Affinities. Acacia effusifolia is most closely related to *A. coolgardiensis* and indeed the two taxa could just as well be treated as subspecies of a single variable species. However, as discussed in the *Introduction* above, we consider that it is best to regard them as species. *Acacia coolgardiensis* is most easily distinguished from *A. effusifolia* by its terete phyllodes that do not exceed 1 mm in width; in *A. effusifolia* the phyllodes are clearly flattened and are (1–)1.5–3 mm wide. The very few specimens that cannot confidently be assigned to *A. coolgardiensis* or *A. effusifolia* based on these phyllode characters mostly occur along the border between the wheatbelt region and the more inland pastoral zone, and also north of Kalgoorlie. Typical representatives of both species are found in these areas and the seemingly intermediate plants may possibly represent hybrids but further study is needed to determine if this is the case. Other characters that help distinguish *A. effusifolia* from *A. coolgardiensis* are its often (but not always) longer spikes and peduncles; in *A. effusifolia* the peduncles are often clearly visible when the spikes are at anthesis, however, when the peduncles are very short (less then 3 mm long) they are obscured by the stamens and the spikes then appear to be sessile as normally occurs in *A. coolgardiensis*. *Acacia effusifolia* has a generally more inland distribution (in the rangeland pastoral country) than *A. coolgardiensis*, which is largely confined to the cropping zone of the wheatbelt. Their distributions overlap in the Mullewa–Yalgoo area where both are common, with *A. coolgardiensis* found on light-textured brown sandy loam soils and *A. effusifolia* on reddish, heavier textured loam-clay soils. These soil types occur in close proximity to one another. At 55.5 km east of Mullewa *A. coolgardiensis* (*B.R. Maslin* 9417) and *A. effusifolia* (*B.R. Maslin* 9418) are sympatric, together with *A. latior* (*B.R. Maslin* 9416). In this same general area there are a few specimens that may possibly represent hybrids between *A effusifolia* and *A. latior*; also, the narrow-phyllode form of *A. latior* that occurs in the Blue Hill Range and elsewhere can be easily confused with *A. effusifolia* (see notes under *A. latior* below).

Acacia thoma is also related to *A. effusifolia*. In *A. thoma* the phyllodes are sometimes linear and care needs to be taken not to confuse these individuals with plants of *A. effusifolia* that have clearly pedunculate spikes. Linear-phyllode forms of *A. thoma* are most readily distinguished from *A. effusifolia* in the following ways (see Maslin & van Leeuwen 2008 further discussion): no red-brown resin hairlets on the peduncles and expanding new shoots, smaller flowers which are less densely arranged in the spikes, and a very small gamosepalous calyx which is less than half the length of the corolla.

There is a remarkable resemblance between *A. effusifolia* and *A. ramulosa* W.Fitzg. var. *ramulosa*, not only superficially in phyllode shape and size but also with respect to the spicate inflorescences and free sepals; the two taxa are sometimes sympatric. Fruiting specimens are easy to distinguish because the terete, striate pods of var. *ramulosa* are much wider (5 mm or more) than those of *A. effusifolia* (1–2 mm). Non-fruiting specimens can be distinguished because in var. *ramulosa* the phyllodes are more rigid and generally greener and straighter than those of *A. effusifolia*, and because its peduncles and new shoots lack the small, red-brown resin hairlets that occur on these organs in *A. effusifolia*.

Variation. The peduncles are very variable in length, ranging from 1 to 8 mm long. Cowan and Maslin (1995: 22) considered that there may be grounds for the recognition of discrete taxa based on peduncle length but this now appears unlikely. There are a few specimens with very narrow (yet flat) phyllodes 1 mm wide scattered throughout the range of the species (e.g. *B.R. Maslin* 3539 and 8608 and *K.R. Newbey* 2580). Specimens with atypically short phyllodes (about 4 cm long) have been collected from Bimbijy Station, 60 km SE of Paynes Find (*S. Pignatti* 483) and Gabyon Station, about 40 km WNW of Yalgoo (*A.A. Mitchell* 914).

Notes. There is little reliable information regarding the stem fluting or bark characteristics in this species. It seems probable, however, that like most other members of the *A. coolgardiensis* group (*A. incognita* excepted) the stems of mature plants of *A. effusifolia* are variably fluted and the bark is smooth except at the base of stems on oldest plants. Further data is needed to confirm these observations which are based on limited herbarium label information.

Acacia incognita Maslin & Buscumb, *sp. nov.*

Fruticuli obconici vel *arbores* 3–5 m alti; *caulis principalis* aliquantum irregularis, non striatus. *Cortex* longitudinaliter fissurata. *Ramuli* glabri vel obscure appresse pilosi. *Surculi* novi glabri. *Phyllodia* teretia vel plana, plerumque 7–12 cm longa, 1–1.2 mm lata, gracilia, non vel vix resinosa, glabra vel inconspicuo apprese pilosa, viridia vel interdum griseo-viridia, tenuiter longitudinaliter multi-striata, innocua vel grosse pungentia. *Inflorescentiae* simplices, 1 vel interdum 2 intra axillam phyllodiorum positae; *capitula* globularia vel breviter obloidea, 4–6 × 4–5 mm (in statu sicco); *pedunculi* plerumque 4–6 mm longi, graciles, glabri vel sub-glabri. *Flores* 5-meri; *sepala* lineari-spathulata, libera vel 1/4 connata. *Legumina* teretia, 3.5–10 mm longa, 1–2 mm lata, tenuiter coriacea-crustacea, ± obscure longitudinaliter nervata. *Semina* in legumine longitudinalia, anguste ellipsoidea vel interdum anguste obloidea, 3–5 mm longa, *c.* 1 mm lata; *arillus* albus vel eburneus.

Typus: Karara Station, approximately 1 km E of Mt Karara camp (Gindalbie Metals), 29° 09' 19.2" S, 116° 48' 27.6" E, 13 February 2008, *D. Coultas and C. Anderson* WT01 (*holo*: PERTH 07692358; *iso*: AD, CANB, K, MEL, NSW, NY).

Obconic *shrubs* or *trees* 3–5 m tall, dividing at or near ground level into many main stems, oldest plants often single-stemmed, young and adolescent plants with bushy, rounded crowns, the crowns (mature plants) to 5 m across and becoming sparse as plants age; main stems slightly crooked and not fluted. *Bark* grey, longitudinally fissured on stems and normally also the branches, exfoliating in short strips when old, smooth on young plants. *Branchlets* terete but often sub-angled or ± flattened at extremities, obscurely ribbed, the ribs not resin-encrusted but branchlet extremities often with a thin veneer of resin over entire surface, not viscid, glabrous or with somewhat obscure, appressed, silvery hairs between the ribs, pale yellow at extremities. *New shoots* light green, with a thick coating of resin when initiated but the resin forming a thin veneer as the shoots expand, not viscid, glabrous but often with scattered, microscopic, red-brown resin hairlets that are soon lost as shoots expand. *Phyllodes* commonly sub-terete to flat, sometimes terete, (4–)7–12 cm long, (0.8–)1–1.2(–1.5) mm wide, slender, not especially rigid, ascending to erect, straight to shallowly incurved, dull to very slightly shiny, not resinous or sometimes with a thin, obscure veneer of resin, not viscid, glabrous or with minute, obscure, appressed hairs mainly between the nerves, green or sometimes greyish green; *longitudinal nerves* numerous, fine, close together, of ± uniform prominence, very slightly raised (when dry); *apex* acute, terminated by a sub-straight to sub-uncinate, hard, brown, innocuous to coarsely pungent point; *pulvinus* 1.5–3 mm long, pale orange (often drying brownish) or sometimes yellow, ± obscurely transversely wrinkled. *Gland* inconspicuous, situated on upper margin of phyllode 0–1.5 mm above the pulvinus. *Inflorescences* simple, 1 or occasionally 2 within axils of phyllodes; *heads* usually globular to short-obloid, 4–6 × 4–5 mm (when dry), golden; *receptacles* usually 1–2 mm long, glabrous or sprinkled with short spreading hairs (no resin hairlets); *peduncles* usually (3–)4–6(–7) mm long, slender (0.3–0.4 mm diam. when in flower), glabrous or sometimes sparsely appressed-hairy, sometimes sprinkled with red or light brown resin hairlets, ± resinous, often dull yellow to tinged orange. *Bracteoles* linear-spathulate, 0.6–0.8 mm long, laminae sparsely ciliolate. *Flowers* 5-merous; *sepals* linear-spathulate, 0.6–1 mm long, free to 1/4 fused, 1/3–1/2 the length of petals; *petals* 1.3–1.5 mm long, glabrous. *Pods* terete, mostly very slightly constricted between seeds, 3.5–10 cm long, 1–2 mm wide, thinly coriaceous-crustaceous, straight to shallowly curved, dark red-brown, old pods sometimes scurfy, with a thin veneer of resin over entire surface, glabrous or sometimes (especially when young) with minute, silvery, appressed hairs between the nerves, ± obscurely longitudinally nerved, marginal nerve not thickened. *Seeds* longitudinal in pod, narrowly ellipsoid or sometimes narrowly obloid, 3–5 mm long, *c.* 1 mm wide, shiny, brown, peripheral nerve often darker-coloured; *pleurogram* very obscure; *areole* small (0.1–0.4 mm long), u-shaped with opening towards the hilum; *funicle* short and filiform, expanded into a fleshy, ± membranous, white to creamy white, terminal *aril* 1–3 mm long (up to *c.* 1/4 length of the seed).

Characteristic features. Obconic *shrubs* or *trees* 3–5 m tall, the main stems slightly crooked and not fluted. *Bark* longitudinally fissured on stems and normally also on the branches. *Branchlet* ribs without an overburden of resin but branchlet extremities often with a thin veneer of resin over entire surface, glabrous or obscurely appressed-hairy. *New shoots* glabrous. *Phyllodes* terete to flat, mostly 7–12 cm long and *c.* 1 mm wide, slender, not especially rigid, dull to very slightly shiny, not or scarcely resinous, glabrous or inconspicuously appressed-hairy, green or sometimes greyish green, finely longitudinally multi-striate; *apex* innocuous to coarsely pungent. *Inflorescences* simple, 1 or occasionally 2 within axils of phyllodes; *heads* globular to short-obloid, usually 4–6 × 4–5 mm (when dry); *peduncles* mostly 4–6 mm long, slender, glabrous or sub-glabrous. *Flowers* 5-merous; *sepals* free to 1/4 fused. *Pods* terete, mostly very slightly constricted between seeds, 3.5–10 cm long, 1–2 mm wide, thin-textured, ± obscurely longitudinally nerved. *Seeds* longitudinal in pod, 3–5 mm long, *c.* 1 mm wide; *aril* ± membranous, white to creamy white, up to *c.* 1/4 length of the seed.

Selected specimens examined. WESTERN AUSTRALIA: on Tenindewa Road North, 1 km N of Greenough River [about 40 km E of Mullewa], 23 June 1998, *P. Armstrong* S54A (PERTH); 36 miles [58 km] S of Yalgoo, 28 Oct. 1974, *J.S. Beard* 7189 (PERTH); Karara Station, *c.* 1 km W of Mount Karara, 3 Sep. 2007, *D. Coultas, F. Obbens & C. Anderson* AS-02 (AD, PERTH); S side of Mungada Road, Mount Karara Station, 29 Nov. 2006, *C. Godden & B. Taylor* DP5A-1 (PERTH); Karara Station, Gindalbie Iron Ore Project, 12 Sep. 2006, *C. Godden, D. Coultas & K. Rodda* GIND Opp 9 (PERTH); Barnong Station, *c.* 0.7 km S of Red Lake Well and 3.9 km SSW of Mugga Mugga Hill, *c.* 60.5 km SW of Yalgoo, 27 Sep. 2006, *A. Markey & S. Dillon* 5205 (PERTH); 29 km W of Yalgoo on the road to Mullewa, 1 Aug. 1975, *B.R. Maslin* 3625 (PERTH); 59 km W of Yalgoo towards Mullewa, 31 Aug. 1976, *B.R. Maslin* 4262 (PERTH); 48 km W of Yalgoo on the road to Mullewa, 3 Apr. 1992, *B.R. Maslin* 7110 (CANB, NSW, NY, PERTH) and *B.R. Maslin* 7112 (K, MEL, PERTH); about 80 km due E of Morawa, Blue Hill Range area, 7.8 km N of Gindalbie Mining Exploration Camp on road to Mungada Ridge, 19 July 2007, *B.R. Maslin* 9127 (PERTH); 46.5 km E of Mullewa on the road to Yalgoo, 25 Jan. 2008, *B.R. Maslin* 9412 (AD, CANB, K, MEL, NSW, NY, PERTH); Karara Station, about 3 km ENE of Gindalbie Metals mining camp entrance on road to Mungada Ridge, early Dec. 2007, *F. Rose s.n.* (PERTH 07692374).

Distribution. Acacia incognita is found from the vicinity of Mullewa and Yalgoo south to Karara Station (located about 80 km E of Morawa) and is often locally common. There are many collections from Blue Hill Range on Karara Station where it occurs in a number of populations, especially on the flats at the base of the 'Karara Range' (an informal name used for the discrete range that incorporates Mt Karara). *Acacia incognita* is also common about 110 km north of Karara Station where it occurs in a series of populations between about 20 to 30 km west of Yalgoo on the road to Mullewa. There are sporadic occurrences from west of Mullewa and in the region between Mullewa–Yalgoo. In the field *A. incognita* can easily be over-looked because it does not posses any particularly distinctive features and also because it superficially resembles the widespread and common species *A. coolgardiensis* (see below under *Affinities*). Therefore, further study is needed to define the geographic range of this species more precisely.

Habitat. Acacia incognita occurs in a semi-arid region at the western extremity of the Eremean Botanical Province near where it adjoins the species-rich South West Botanical Province. The area receives an annual rainfall of 250–300 mm with the highest falls occurring during the winter months of June and July; sporadic rainfall may also occur at other times of the year. It grows on red to red-brown loam or loamy clay (often with a stony or sandy surface) in Open Woodland or Mallee Woodland dominated by species of *Eucalyptus* (*E. ewartiana*, *E. kochii* subsp. *amaryssia* and *E. loxophleba* subsp. *supralaevis*) or shrubland dominated by *Melaleuca leiocarpa.* Associated *Acacia* species include *A. anthochaera,* *A. burkittii, A. effusifolia, A. obtecta, A. ramulosa* var. *ramulosa* and *A. tetragonophylla.* It grows on either low rises or on flat plains. On Karara Station it is found on the lower slopes and adjacent flats surrounding low banded ironstone ranges.

Flowering and fruiting period. Extant collections show that plants of *A. incognita* flower in January, February, April, September and October. However, based on limited field knowledge and relatively few specimens, it appears that only a proportion of the biologically mature plants within the populations flower at any one time. It seems likely that this species flowers quickly and opportunistically in response to the timing of rainfall and to the amount of water reaching individual plants. Judging from the above phenology it appears that this species flowers following both summer and winter rains. Plants with mature seed have been collected in late October and early December, and some with very few seeds in July and August.

Conservation status. Not considered rare or endangered.

Etymology. The botanical name is derived from the Latin *incognitus* (unknown). It has been selected because the identity of this species has gone unrecognised until now on account of its superficial resemblance to *A. coolgardiensis.*

Common name. False Sugar Brother is suggested here as an appropriate common name.

Affinities. *Acacia incognita* is most closely related to the more widely distributed *A. coolgardiensis*. Indeed, in the past the two species were often confused because they have a similar growth form, long, slender, multi-striate phyllodes and often grow in close proximity to one another. Other significant characters shared by the two species include their resin-encrusted new shoots, free or partially united sepals, terete, narrow, thin-textured, obscurely striate pods and similar seeds. However, a careful examination of the plants enable the two species to be distinguished reliably. In the field *A. coolgardiensis* can be recognised by its smooth bark (except finely longitudinally fissured at extreme base of stems on oldest plants) and its stems which possess few to numerous, shallow to deep, longitudinal flutings. *Acacia incognita* on the other hand has longitudinally fissured bark on the main stems and this bark normally extends to the upper branches, furthermore, its stems are not fluted (although occasional depressions do occur on the stems where branches have abscised but these are not homologous with the distinctive longitudinal flutings that characterize *A. coolgardiensis* and other taxa in the '*A. coolgardiensis* group'). The two species grow close to one another (a few kilometres apart) on Karara Station and in the Mullewa–Yalgoo area; however, they seem not to co-occur, with *A. coolgardiensis* favouring more lighter-textured soils than those on which *A. incognita* occurs. On herbarium specimens the easiest way to distinguish the two species is that in *A. coolgardiensis* the heads are normally obloid to short-cylindrical (although sometimes they are globular), relatively large (mostly 5–9 × 5–6 mm at anthesis when dry), mostly paired within the axils of the phyllodes and importantly, normally appearing sessile because their stout peduncles (which are about twice as thick as those of *A. incognita*) are very short (0.5–2(–3) mm long) and are normally obscured by the stamens at anthesis. In *A. incognita* the heads are usually globular to short-obloid, 4–6 × 4–5 mm (when dry), single or occasionally paired within axils of phyllodes, and on slender peduncles usually (3–)4–6(–7) mm long which are clearly visible when the heads are at anthesis. Other characters useful in recognizing *A. coolgardiensis* include its often resin-ribbed branchlets (ribs never with an overburden of resin in *A. incognita*) and its phyllodes which are never flat and which are commonly more grey in colour than those of *A. incognita.*

Notwithstanding the above differences between *A. incognita* and *A. coolgardiensis*, a closer examination of populations between Morawa and Yalgoo may be instructive in understanding the relationship between these two species better. Recent collections (of sterile material with terete phyllodes) in this area by the first author suggest the possibility of hybridity between *A. incognita* and *A. coolgardiensis* (see *B.R. Maslin* 9402, PERTH), but flowering material and probably genetic studies are needed to understand the taxonomic complexities better. A sterile specimen referred to *A. effusifolia* on account of its flat phyllodes was also collected from a different population in this same general area (see *B.R. Maslin* 9403, PERTH); in the field this plant had a similar facies to *B.R. Maslin* 9402 and it should also be included in any such study.

Acacia incognita is sometimes sympatric or parapatric with two other members of the '*A. coolgardiensis* group', *A. effusifolia* and *A. latior*, but is distinguished from both by its non-fluted stems, generally narrower, greener and often terete phyllodes and smaller heads on slender, glabrous or sparsely hairy peduncles.

Some specimens of *A. resinosa* are superficially very similar to those of *A. incognita* in having terete, finely multi-striate, green phyllodes, pedunculate heads and narrow pods. However, the two species are not especially closely related, with *A. resinosa* being most readily recognised by its gamosepalous calyx (sepals united for most of their length), resinous heads (making it difficult to tease-out individual flowers when heads are in bud) and flat, non-striate pods.

Variation. The phyllodes on plants from Karara Station vary from sub-terete to flat with often a few terete ones interspersed. This also applies to most plants in the Mullewa–Yalgoo populations but in this area it is possible to find plants with consistently terete phyllodes. For example, *B.R. Maslin* 7112 (48 km west of Yalgoo) has terete phyllodes and occurred in a population dominated by plants with compressed phyllodes (see *B.R. Maslin* 7110). The phyllodes are consistently terete on the four collections from the station country which are discussed below under *Variants*.

Variants. A few specimens (in mature and immature pod with some old flowers persisting) with terete phyllodes from the rangeland pastoral country about 200 km north of Mullewa, appear to be *A. incognita* except that they have longer than normal peduncles (5–12 mm) and receptacles (to 7 mm long). These plants have been collected from between Carey Downs and Callatharra stations (*J.S. Beard* 6848, PERTH), Byro Station (*J.S. Beard* 6855, PERTH), Curbur Station (*A.L. Payne* 111, PERTH) and Yalardy Station (*A.L. Payne* 268, PERTH). These specimens were referred to *A. coolgardiensis* subsp. *coolgardiensis* by Cowan and Maslin (1995: 20) and Cowan (2001: 329). Field studies and flowering material are needed to confirm the identity of these plants. Judging from the length of their fruiting receptacles the flowers will be arranged in distinctly obloid heads or short-cylindrical spikes which will be longer than those found on plants of typical *A. incognita* from more southerly locations (which have globular to short-obloid heads that measure 4–6 mm long when dry).

Another entity with terete phyllodes from the rangelands that has the general facies of *A. incognita* is represented by a few specimens in immature pod from a banded ironstone range on the eastern side of Lake Giles (near Johnson Soak), about 400 km south-east of Mullewa, namely, *A. Markey & S. Dillon* 5212, 5213 and 5214 (all PERTH). This entity differs most obviously from *A. incognita* in having, flat, broader pods (3–4 mm wide) and receptacles 3–5 mm long (suggesting that the flowers would be arranged in obloid heads or short-cylindrical spikes). Unlike the variant discussed above, the Lake Giles variant is not regarded as belonging to *A. incognita*, but it is not far removed from it. It appears to have close affinities with *A. balsamea* (Cowan & Maslin 1999: 417–418) but has less resinous branchlets and phyllodes than that species. Flowering and mature fruiting material and field studies are needed to assess the taxonomic status of the Lake Giles variant.

Acacia latior (R.S.Cowan & Maslin) Maslin & Buscumb, *stat. nov.*

Acacia coolgardiensis subsp. *latior* R.S.Cowan & Maslin, *Nuytsia* 10: 23 (1995). *Type*: 6.4 km E of Mullewa towards Yalgoo, Western Australia, 2 August 1974, *B.R. Maslin* 3629 (*holo*: PERTH 00343188; *iso*: BM, BRI, CANB, G, K, MEL, MO, NSW, NY, PERTH 00718505).

Rounded or obconic, multi-stemmed *shrubs* 1–3(–4) m tall, oldest plants occasionally single-stemmed, the main stems slightly crooked on mature plants, stems ± sparingly and not conspicuously fluted with the flutings often present only towards base of thickest stems, crowns dense and compact with distinctive silvery tips when making new growth. *Bark* dark grey, smooth or finely longitudinally fissured. *New shoots* densely clothed with silvery white appressed hairs, the indumentum sometimes obscured by a reddish brown (when dry) resin when shoot is initiated but this growth phase very brief and not conspicuous, the resin disintegrating and persisting for a short time as scattered, irregularly-shaped, flattened, light brown plates of resin or as scattered reddish resin hairlets as the shoots expand to reveal the characteristic indumentum beneath. *Branchlets* slightly angular or sub-flattened and with minute, silvery, appressed hairs at the slender extremities (1–1.5 mm wide), often glabrous as branchlets mature, obscurely ribbed, the ribs not resinous. *Phyllodes* variable in shape and size, narrowly oblanceolate to linear-oblanceolate, linear-elliptic or linear, narrowed at base, (4–)5–11(–13) cm long, commonly 5–8(–10) mm wide but 2–4 mm wide in narrow-phyllode forms, sub-rigid, erect, straight to shallowly incurved, dull green to grey-green with a distinctive silvery sheen which is especially evident on young and adolescent phyllodes, appressed-hairy (the hairs on young and adolescent phyllodes normally covering entire lamina and often obscuring the nerves, but becoming confined to between the nerves, or sometimes absent, on oldest phyllodes); *longitudinal nerves* numerous, fine, very close together, normally the central nerve slightly more pronounced than the rest; *apex* acute or obtuse, terminated by a hard, innocuous or coarsely pungent, straight or sometimes slightly curved, brown point. *Gland* situated on upper margin of phyllode 0–2 mm above pulvinus. *Inflorescences* simple, normally paired within axils of phyllodes, occasionally 4 per axil; *heads* widely ellipsoid to obloid or short-cylindrical, 8–12 mm long, 5–7 mm wide when dry; *peduncles* 3–7 mm long, moderately to densely silvery appressed-hairy, occasionally with brown resin hairlets intermixed with the orthodox hairs. *Flowers* 5-merous; *calyx c.* 1/2 length of corolla, variably dissected to *c.* 1/2 its length into ± oblong lobes, occasionally dissected to base; *petals* 1.5–2 mm long. *Pods* terete, not or shallowly constricted between the seeds, 2–5 cm long, (1.5–)2–3 mm wide, thinly to moderately coriaceous, straight to shallowly curved, reddish brown, appressed-hairy (hairs moderately dense), very obscurely longitudinally nerved (nerves not raised). *Seeds* longitudinal in the pod, 2–2.5(–3) mm long, 1.2–1.5 mm wide, obloid, shiny, light brown or dark brown; *aril* terminal, fleshy, white and sometimes almost as long as the seed.

Characteristic features. Rounded or obconic, normally multi-stemmed *shrubs,* main stems ± sparingly fluted, crowns dense and compact. *New shoots* densely clothed with silvery white appressed hairs. *Branchlet ribs* obscure and not resinous. *Phyllodes* variable in shape and size, narrowly oblanceolate to linear-oblanceolate, linear-elliptic or linear, narrowed at base, commonly 5–8(–10) mm wide but 2–4 mm wide in narrow-phyllode forms, dull green to grey-green with a distinctive silvery sheen (due to indumentum) which is especially evident on young and adolescent phyllodes, appressed-hairy, with numerous, fine longitudinal nerves which are very close together. *Inflorescences* normally paired within axils of phyllodes; *heads* widely ellipsoid to obloid or short-cylindrical; *peduncles* 3–7 mm long, moderately to densely silvery appressed-hairy. *Flowers* 5-merous; *calyx* variably dissected to *c.* 1/2 its length into oblong lobes, occasionally dissected to base. *Pods* terete, not or shallowly constricted between the seeds, (1.5–)2–3 mm wide, thin-textured, very obscurely longitudinally nerved. *Seeds* small (2–2.5 mm or occasionally 3 mm long).

Selected specimens examined. WESTERN AUSTRALIA: 4 miles [6.4 km] N of Mullewa, 20 Aug. 1965, *J.S. Beard* 4321 (PERTH); White Wells Station, 40 miles [64 km] E of Perenjori, 5 Nov. 1974, *J.S. Beard* 7367 (PERTH – narrow-phyllode form); between Cue and Mount Magnet, 12 July 1931, *W.E. Blackall* 81 (PERTH); Pindar, 16 Sep. 1931, *W.E. Blackall* 668 (PERTH); near exploration camp, Gindalbie mining lease, Karara Station, 5 Feb. 2007, *D. Coultas s.n.* (PERTH 07534736 – narrow-phyllode form); Karara Station, Mount Karara, 23 May 2007, *D. Coultas & C. Anderson s.n.* (PERTH 07464401 – narrow-phyllode form); Blue Hill Range, Windaning Hill, Karara Station *c.* 6.5 km NNE of Mulga Bore and 77 km W of Paynes Find, 17 Sep. 2005, *A. Markey & S. Dillon* 3312 (PERTH – narrow-phyllode form); Blue Hill Range, Karara Station, *c.* 6.5 km ENE of Mungada Well and 4 km ENE of Jasper Hill, *c.* 77 km W of Paynes Find, 22 Sep. 2005, *A. Markey & S. Dillon* 3313 (PERTH – narrow-phyllode form); 60 km W of Yalgoo towards Mullewa, 1 Aug. 1974, *B.R. Maslin* 3626 (PERTH – narrow-phyllode form); Gnows Nest Range, 50 km SE of Yalgoo towards Paynes Find, 31 Aug. 1976, *B.R. Maslin* 4256 (PERTH – narrow-phyllode form); 6.5 km E of Mullewa on the road to Yalgoo, 17 Dec. 1981, *B.R. Maslin* 5076 (PERTH); Karara Station, between Perenjori and Paynes Find), Mount Karara, 27 June 2006, *B.R. Maslin* 8787 (K, MEL, PERTH – narrow-phyllode form); *c.* 100 km due E of Morawa, on Perenjori – Warriedar road, 93 km from turn-off 2 km S of Perenjori, 10 Apr. 2007, *B.R. Maslin* 9113 (CANB, PERTH – narrow-phyllode form); 55.5 km E of Mullewa on the road to Yalgoo, 25 Jan. 2008, *B.R. Maslin* 9416 (PERTH); East Yuna Reserve, *c.* 70 km NE of Geraldton, 33 km WNW of Mullewa, 12–16 Oct. 1976, *B.G. Muir* 51(2.6) (PERTH).

Distribution. Common in the vicinity of Mullewa in the northern wheatbelt region of south-west Western Australia where it extends to about 10 km north, 30 km south and 50 km east of the township; is also grows in the East Yuna Reserve about 30 km west-north-west of Mullewa. There are scattered occurrences to the east of Mullewa (to about 60 km west of Yalgoo), the Gnows Nest Range about 50 km south of Yalgoo, on White Wells Station (about 150 km south of Yalgoo) and especially in the Blue Hill Range and adjacent areas on Karara and Warriedar pastoral stations (now conservation reserves), about 130 km south of Mullewa. A specimen labelled as having been collected from 'between Cue and Mount Magnet' (*W.E. Blackall* 81) is the most easterly known occurrence of the species. This locality is about 100 km east of Yalgoo and located well inside the arid zone; confirming that this locality is correct will be difficult because of the vague locality data provided by the collector. *Acacia latior* often forms dense stands in the places where it grows.

Habitat. Around Mullewa *A. latior* grows in gently undulating country most commonly in shrubland on yellow or pale brown, often gravelly, sand or sandy loam. In the Blue Hill Range area and in some areas to the east of Mullewa, it is found on heavier, red-brown, loam clay loam soils in open *Eucalyptus* woodland. The narrow-phyllode form of *A. latior* found in the Blue Hill Range (see below under *Variation*) is common on mid to upper slopes of Banded Ironstone formations in open woodland and shrubland with *Melaleuca leiocarpa*, *Eucalyptus leptopoda* and *Acacia* species (e.g. *A. aneura*, *A. quadrimarginea*, *A. sibina* and *A ramulosa* (Markey & Dillon, in review).

Flowering and fruiting period. Flowers from June to August or sometimes September. Pods with mature seeds have been collected in November and December.

Conservation status. Not considered rare or endangered.

Etymology. The botanical name is derived from the Latin *latus* (broad) and was created by Cowan and Maslin (1995: 22–23) because broad phyllodes effectively distinguished the taxon from the other two subspecies of *A. coolgardiensis*. At that time, however, it was not known that atypically narrow-phyllode forms of the taxon were common in the Blue Hill Range area, nor was *A. sulcaticaulis* known. However, even though broad phyllodes are not diagnostic for the taxon within the context of the '*A. coolgardiensis* group' the epithet is retained because it has been in use for over a decade.

Common name. Broad-leaf Sugar Brother is suggested as a common name for this new species.

Affinities. Acacia latior is parapatric and/or sympatric with *A. coolgardiensis*, *A. effusifolia* and *A. incognita* in the Mullewa area and is most readily recognised by its broad, flat phyllodes, conspicuously silvery white-hairy new shoots and non-resinous branchlet ribs. In the field *A. latior* is seen to have a lower stature (plants not above 3–4 m tall) and a denser, more compact crown than its relatives. There are a few specimens collected from between Mullewa and Yalgoo that, judging from morphological criteria, may possibly represent hybrids between *A. effusifolia* and *A. latior* (namely, *J.S. Beard* 7163, *R.J. Cumming* 1952 and *B.R. Maslin* 4261, 7111 & 7803, all PERTH). *Acacia latior* is also related to *A. sulcaticaulis* from Mt Mulgine (see under that species below for discussion).

The narrow-phyllode form of *A. latior* (see above) which is common in the Blue Hill Range and adjacent areas on Karara Station is sometimes sympatric with plants provisionally identified as *A. effusifolia.* The latter species is seemingly uncommon in this area and most of the few specimens seen are sterile (except one that possessed a few seeds). These two entities closely resemble one another superficially but *A. latior* is recognised most reliably by its conspicuous, densely hairy new shoots with the indumentum persisting to the adolescent and often mature phyllodes (hairs often obscuring the nerves) which have a distinctive silvery sheen. Although the new shoots of *A. effusifolia* are hairy the indumentum is much less conspicuous and the hairs are confined to between the phyllode nerves. Also, the seeds of *A. effusifolia* are slightly longer (3–4 mm) than those of *A. latior* (2.5–3 mm). *Acacia ramulosa*. var. *ramulosa,* which is relatively common in the Karara area, is often sympatric with *A. latior* and/or *A. effusifolia* and can be confused with these species on account of having narrowly linear, finely multi-striate phyllodes and pedunculate, spicate inflorescences. Fruiting specimens of var. *ramulosa* are easy to recognise because the terete pods are strongly striate-nerved and 5 mm or more wide. Sterile or flowering specimens can be problematic but var. *ramulosa* can generally be recognised by its more rigid and generally greener and straighter phyllodes. Also, the peduncles of this variety lack the red resin hairlets that occur on *A. effusifolia* and sometimes *A. latior*, and its new shoots are not conspicuously hairy, nor are its adolescent and mature phyllodes silvery as in *A. latior*. Notwithstanding these differences, it is often difficult to name plants in the Blue Hill Range area confidently.

Variation. Acacia latior is very variable in its phyllode shape and size. Around Mullewa the species is readily recognised (and distinguished from all other members of the '*A. coolgardiensis* group') by its oblanceolate phyllodes which are normally about 5–8 cm long and 5–8 mm wide. However, in the Blue Hill Range area, 130 km south of Mullewa, the phyllodes are generally linear (but narrowed at their base), long (often 7–11 cm) and narrow (2–4 mm wide). Notwithstanding these phyllode differences the Blue Hill Range populations are clearly referable to *A. latior* on the basis of the following characters: plants 2–3(–4) m tall with a dense crown, branchlet ribs obscure and not resinous, new shoots with a conspicuous, silvery white, dense indumentum, phyllodes with numerous, very fine, narrow longitudinal nerves that are very close together and apical points that are normally straight (occasionally shallowly curved), peduncles 2–6 mm long with a moderate to dense indumentum (rarely with reddish resin hairlets intermixed with the orthodox hairs) and seeds relatively small. Plants with narrow phyllodes have also been collected from between Mullewa and Yalgoo (e.g. *B.R. Maslin* 3626), from south of Yalgoo towards the Blue Hill Range, e.g. Gnows Nest Range (*B.R. Maslin* 4256) and Mount Warriedar (*B.R. Maslin* 9113), and from White Wells Station about 50 km south-east of Blue Hill Range (*J.S. Beard* 7367). While these narrow-phyllode forms may possibly represent a discrete entity (an infraspecific taxon of *A. latior*), an examination of the above-mentioned collections and field studies throughout much of the geographic range of *A. latior* suggest that there is clinal variation in phyllode width, with the narrowest forms found in the Blue Hill Range area. Further study is warranted to better-elucidate the nature of phyllode variation within this species better; such studies may benefit from an examination of the relationship between phyllode width and soil type (pale coloured sand-loam vs reddish brown clay-loam) on which the plants occur. As discussed under *Affinities* above, the narrow-phyllode forms of *A. latior* are superficially very similar to *A. effusifolia.*

Acacia sulcaticaulis Maslin & Buscumb, *sp. nov.*

Fruticuli (raro arbores) multi-caules, obconici vel anguste obconici; *caules* longitudinaliter striati. *Ramuli* ad extremitates applanati. *Surculi* novi leviter resinosi, ± glabri. *Phyllodia* anguste elliptica, (4–)5–10(–14) cm longi, 5–10 mm lati, tenuiter multi-striata, nervis numerosis, confertis parallelis, spatio internervis glabris vel microscopicaliter appresso-pilosis. *Inflorescentiae* simplices; *capitula* obloidea; *pedunculi* brevi (3–7 mm), glabri vel sparse appresso-pilosi, ± resinosi. *Flores* 5-meri; *sepala* spathulata, libera vel partialiter connata. *Legumina* teretis, non vel tantum leviter inter semina constricta, parva (20–35 × 1.4–1.8 mm), tenuiter crustacea vel tenuiter coriacea, ±recta, rubro-brunnea, ±glabra. *Semina* areola minima.

Typus: east of Morawa, Western Australia [precise locality withheld for conservation reasons], 4 September 2007, *D. Coultas & C. Anderson* AS-04 (*holo*: PERTH 07577478; *iso*: CANB, K, MEL).

Multi-stemmed, obconic or narrowly obconic *shrubs* (1–)2–4 m tall, rarely *trees* to 6 m tall, phyllodes concentrated towards ends of branches (crowns occupy about 1/5 of total plant height), stems and main branches obviously longitudinally fluted. *Bark* dark grey, smooth. *Branchlets* clearly flattened and 1.5–2.5 mm wide at extremities, ageing terete, obscurely ribbed, sometimes lightly resinous (but not viscid), the resin forming a very thin veneer over surface, glabrous or with microscopic, silvery, straight, appressed hairs that are commonly confined to immediately below insertion of phyllodes, yellow-green to pale orange-brown at extremities, aging dull reddish then grey. *New shoots* lightly resinous and viscid (but not sticky when dry), glabrous or with microscopic, appressed, straight, white hairs between the phyllode nerves when initiated. *Phyllodes* mostly narrowly elliptic, (4–)5–10(–14) cm long, 5–10 mm wide, coriaceous, mostly straight but some slightly curved, dull green, not resinous or slightly resinous, glabrous or with microscopic, appressed, straight, white hairs between the nerves (hairs very difficult to see); *longitudinal nerves* numerous, close together, fine and of uniform prominence or the central one slightly more pronounced than the rest, slightly raised (when dry); *marginal nerve* discrete but not prominent, yellow; *apex* acute, not pungent. *Gland* situated on upper margin of phyllode 0–2 mm above the pulvinus, obscure. *Inflorescences* simple, one or two within axils of phyllodes; *heads* obloid, 8–12 × 6–8 mm when dry, golden; *peduncles* 3–7 mm (shortest peduncles ± obscured by stamens with the heads then superficially appearing sessile), glabrous to very sparsely appressed-hairy, ± resinous. *Bracteoles* similar to sepals, sub-peltate, 1.2–1.5 mm long; *claws* narrowly oblong to linear; *laminae* ± ovate, *c.* 0.5 mm wide, thickened abaxially and dark brown. *Flowers* 5-merous; *sepals* 3/5–3/4 length of petals, spathulate, 1.2 –1.4 mm long, free to base or fused for *c.* 1/4 (rarely 1/2) their length, sparsely hairy, claws narrowly linear, laminae brown; *petals* 2.2–2.5 mm long, glabrous. *Pods* terete, not or very slightly constricted between the seeds, 20–35 mm long, 1.4–1.8 mm wide, thinly crustaceous to thinly coriaceous, straight or almost so (the valves shallowly recurved following dehiscence), red-brown, glabrous or sub-glabrous (sprinkled with microscopic, straight, closely appressed hairs which are difficult to see). *Seeds* longitudinal in the pod, obloid, 2–2.5 mm long, 0.9–1.2 mm wide, turgid, with a satin lustre, mid-brown but sometimes dull yellowish near the centre, peripheral nerve dark-coloured; *areole* u- to v-shaped, extremely small (0.1–0.2 mm long,) open towards the hilum; *funicle* expanded into a fleshy, white *aril.*

Characteristic features. Multi-stemmed obconic to narrowly obconic *shrubs* (rarely *trees*) with longitudinally fluted, smooth stems. *Branchlets* flattened at extremities. *New shoots* lightly resinous, ± glabrous. *Phyllodes* narrowly elliptic, finely multi-striate with numerous, close, parallel nerves, glabrous or microscopically appressed-hairy between the nerves. *Heads* obloid; *peduncles* 3–7 mm long, glabrous to very sparsely appressed-hairy, ± resinous. *Flowers* 5-merous; *sepals* spathulate, free or fused for *c.* 1/4 (rarely 1/2) their length. *Pods* terete, not or very slightly constricted between the seeds, small (20–35 × 1.4–1.8 mm wide), thinly crustaceous to thinly coriaceous, ±straight, red-brown, ± glabrous. *Seeds* with extremely small *areole.*

Other specimens examined. WESTERN AUSTRALIA: [localities withheld] 24 Apr. 2007, *D. Coultas & K. Greenacre* VM-06 (PERTH); 18 May 2007, *D. Coultas & C. Anderson* DCCA-05 (PERTH); 29 Oct. 2007, *D. Coultas & C. Anderson s.n.* (PERTH 07577508); 11 Dec. 2007, *D. Coultas & C. Anderson* 14 (PERTH); 17 July 2007, *B.R. Maslin* 9124 (AD, NSW, PERTH); 2 Oct. 2007, *B.R. Maslin et al.* BRM 9129 (PERTH).

Distribution. Acacia sulcaticaulis is known from the vicinity of Mt Mulgine in the Midwest region of Western Australia about 90 km east of Morawa. It is locally abundant. The general area in which the new species occurs is relatively poorly collected, therefore it is possible that other populations will be found in the future. However, as can be seen below the Mt Mulgine populations are seemingly habitat-specific to areas of quartz substrate and if this proves correct it may constrain the places where *A. sulcaticaulis* will grow.

Habitat. The new species occurs in a semi-arid area with an annual rainfall of 250–300 mm, most of which falls between late autumn and early winter (May to July). It typically grows in dense shrubland with *Acacia burkittii* and *Allocasuarina acutivalvis* on skeletal, red silty loam, on steep slopes, ridges and along the rocky creek courses. Althought the Mt Mulgine area has a complex geology *A. sulcaticaulis* seems to favour areas where quartz predominates in the soil.

Flowering and fruiting period. Because of the paucity of collections it is difficult to determine the flowering and fruiting period for this new species accurately; furthermore, it is likely that, as with many other arid zone species of *Acacia,* this one responds opportunistically to rainfall. Based on the material to hand (all collected in 2007) plants were at full anthesis in early September and pods with mature seeds occurred in early to mid-December. It is possible that *A. sulcaticaulis* has a relatively short flowering period of perhaps only about one month. It is estimated that in 2007 flowering probably commenced around the middle of August, however, because the onset of flowering is possibly dependent upon the timing and intensity of autumn/winter rainfall, the flowering period (and also the fruiting period) may vary slightly from year to year.

Conservation status. Acacia sulcaticaulis is recently listed as Priority One under DEC Conservation Codes for Western Australian Flora.

Etymology The botanical name is derived from the Latin *sulcus* (furrow, groove) and *caulis* (stem) in reference to the characteristic fluting (with furrows between the raised flutes) found on stems and branches.

Common name. Mt Mulgine Fluted Wattle

Affinities. *Acacia sulcaticaulis* has many characters that justify its inclusion in the '*A. coolgardiensis* group', most particularly its fluted stems, finely multi-striate phyllodes, obloid heads, free or partially fused sepals, terete, thin-textured and obscurely nerved pods. The new species is, however, readily distinguished from all other members of this group by its clearly flattened branchlet apices; other characters that help characterise this geographically restricted species include its broad, glabrous (or indistinctly appressed hairy), green phyllodes, its short-pedunculate heads and its small pods.

Acacia sulcaticaulis is most closely related to *A. latior* on account of its non resin-ribbed branchlets, broad phyllodes and pedunculate heads but *A. latior* is distinguished in the following ways:

- Phyllodes generally broadest above the middle, silvery grey-green and invested with a layer of short, closely-appressed, glistening hairs (the hairs dense on young and adolescent phyllodes and tend to cover the entire surface of the lamina, on oldest phyllodes the hairs are normally confined to between the nerves: observe at ×10 magnification). In *A. sulcaticaulis* the phyllodes are broadest near the middle, they are bright green in colour and are either glabrous or possess microscopic hairs between the nerves (the hairs are normally sparser and much more difficult to see than those of *A. latior*). Also, the phyllodes of *A. latior* tend to be more obviously tapered towards the base and commonly slightly narrower than those of *A. sulcaticaulis*.

- Expanding new shoots densely and obviously hairy (glabrous or indistinctly hairy *A. sulcaticaulis*).

- Branchlet apices slender (1–1.5 mm wide) and ± angular or sub-flattened (1.5–2.5 mm wide and clearly flattened in *A. sulcaticaulis*). Also, in *A. latior* the branchlet apices are more obviously appressed-hairy than those of *A. sulcaticaulis*.

- Peduncles moderately to densely appressed-hairy (glabrous or sparsely appressed-hairy in *A. sulcaticaulis*).

- Pods slightly wider (2–3 mm) and with a more obvious indumentum (hairs moderately dense). In *A. sulcaticaulis* the pods are less than 2 mm wide and glabrous or almost so.

The phyllode nerves, and sometimes the phyllode shape and size of *A. sulcaticaulis* are similar to those of the more southerly distributed *A. warramaba* Maslin (1982: 108). However, the two species are not closely related, with *A. warramaba* most readily distinguished by its non-fluted stems, ± uncinate phyllodes, racemose inflorescences, globular heads which are smaller (3.5–4 mm diam.) and flat pods which are 6–8 mm wide. The general field facies of *A. sulcaticaulis* is reminiscent of *A. kempeana* F.Muell. but the two species are not closely related, *A. kempeana* being readily recognised by its non-fluted stems, gamosepalous calyx and papery pods which are 1 cm or more wide.

Variation. *Acacia sulcaticaulis* is normally a narrowly obconic shrub 2–4 m tall, but the shape and height of the plants can vary depending on the habitat. On favourable sites (i.e. deep soil along watercourses at the base of Mt Mulgine) plants may attain a height of about 6 m, whereas on exposed sites in skeletal soil around granite outcrops towards the summit of Mt Mulgine they are often low shrubs 1–1.5 m tall with wide-spreading crowns. This range of variation is seen in many other *Acacia* species and is not considered unusual.

Discovery. This species has only recently been discovered. It was first collected by David Coultas and Kylie Greenacre in April 2007 while undertaking botanical surveys in the Mt Mulgine area.

Acknowledgements

We wish to thank Gindalbie Metals Ltd for their generous financial and other support of this study. We also thank the staff of Woodman Environmental Consulting (namely David Coultas, Cathy Godden and Frank Obbens) for providing specimens and information concerning the plants growing on Gindalbie lease areas on Karara Station and Fred Rose (Gindalbie Metals Ltd) for providing a seed collection of *A. incognita* from the Blue Hill Range area. Paul Wilson is thanked for providing the Latin descriptions.

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Acacia diallaga (Leguminosae: Mimosoideae), a new geographically restricted species with diallagous phyllodes from the Midwest Region of south-west Western Australia

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Abstract

Maslin, B.R. & Buscumb, C. *Acacia diallaga* (Leguminosae: Mimosoideae), a new geographically restricted species with diallagous phyllodes from the Midwest Region of south-west Western Australia. *Nuytsia* 18: 127–132 (2008). *Acacia diallaga* Maslin & Buscumb, a new species of *Acacia* sect. *Juliflorae* (Benth.) C.Moore & Betche restricted to a small area east of Morawa in the Midwest Region of Western Australia is described. A feature of the new species (and one from which the botanical name is derived) is that during times of drought the phyllodes turn a purplish colour, reverting to their normal glaucous to sub-glaucous colour when conditions improve. This process of foliage colour change related to weather conditions occurs also in *A. subsessilis* A.R.Chapman & Maslin which is the closest relative of *A. diallaga*. The new species is listed as a Priority Two species according to the Department of Environment and Conservation's Conservation Codes for Western Australian Flora.

Introduction

The new species described here, *Acacia diallaga* Maslin & Buscumb, is referable to *Acacia* sect. *Juliflorae* (Benth.) C.Moore & Betche and is most closely related to *A. subsessilis* A.R.Chapman & Maslin. Both these species exhibit a change in colour of their foliage (to a light purple and reddish respectively) during periods of drought, reverting to normal foliage colour when conditions improve. As discussed below, the term diallagous is used to describe this phenomenon of foliage changing colour and reversing back according to certain weather conditions.

Acacia diallaga was discovered in 2006 and based on current evidence seems to be geographically restricted to a small area on Karara and Warriedar Stations, about 100 km east of Morawa. Because the species grows on and near areas covered by mining exploration leases it is deemed desirable to formalize its name and to assess its conservation status in anticipation of future mining development in the area.

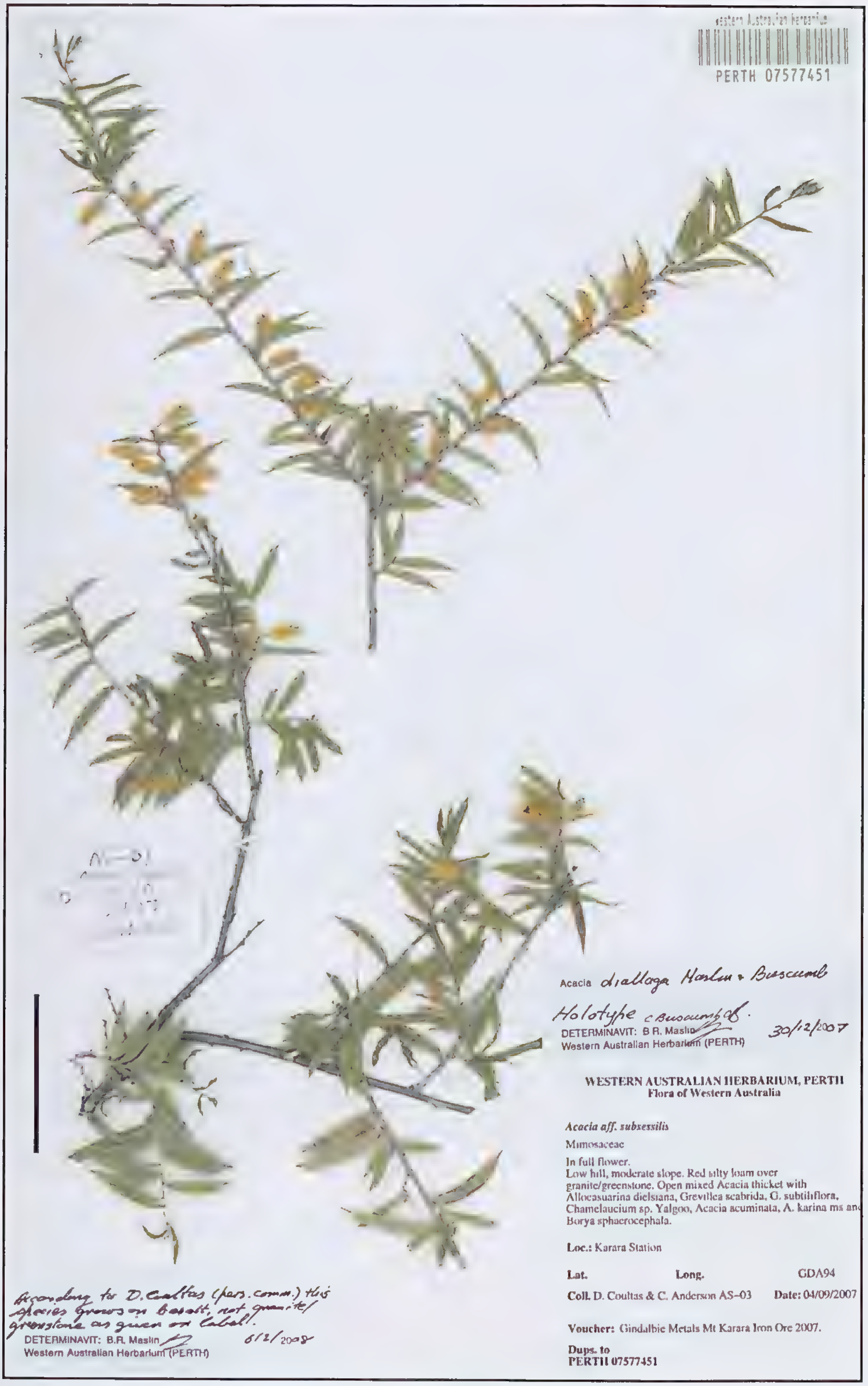
Taxonomy

Acacia diallaga Maslin & Buscumb, *sp. nov.*

Frutex effusus multiramosus 0.5–1.5(–3) m altus. *Phyllodia* asymmetrice anguste elliptica vel anguste oblongo-elliptica vel lanceolata, (3–)5–6(–7) mm lata, ± patentia, glabra, glauca vel sub-glauca, vel purpureo-rubra mutata in statu siccitate, nervis longitudinalis principalis 3, nervis minoribus anastomosans interpositis, apice pungenti; pulvinus multi-redactus. *Spicae* breves (5–10 mm in statu sicco); *pedunculus* brevis (2–4 mm), glaber vel sub-glaber; *bractea basalis* peduncularis saepe persistentia. *Bracteolae* peltatae, caducae. *Flores* 5-meri; *calyx* breviter dissectus; *petala* 1.3–1.5 mm longa. *Legumina* anguste oblonga, 4 mm lata, ad marginem recta vel inter-semina leviter constricta, tenuiter coriacea, glabra. *Semina* obloidea, 3 × 2 mm, nigra; *areola* minima (*c.* 0.2 mm longa); arillus in extremo seminis sub-lateraliter dispositus.

Typus. Karara Station, Western Australia [precise locality withheld for conservation reasons], 4 September 2007, *D. Coultas & C. Anderson* AS-03 (*holo*: PERTH 07577451; *iso*: K, MEL).

Dense, spreading, much-branched *shrubs* 0.5–1.5(–3) m tall, domed or ± obconic with rounded crowns. *Bark* grey, slightly rough on main stems (fibrous at their base on oldest plants), smoother on the upper branches. *Branchlets* terete, obscurely ribbed, lenticellate with scattered lenticels, glabrous, red-brown (but often covered with a light grey, translucent, exfoliating epidermis), aging grey, ± yellowish orange on young growth, the oldest branchlets marked with raised scars where phyllodes have fallen. *Stipules* early caducous, united. *Phyllodes* on raised stem projections, narrowly elliptic to narrowly oblong-elliptic or lanceolate, slightly asymmetric with lower margin straight to shallowly concave and upper margin shallowly convex, (11–)15–36 mm long, (3–)5–6(–7) mm wide, rigid, ± patent to slightly inclined or reclined, straight to shallowly recurved, glabrous, glaucous to sub-glaucous (green when young on new shoots), changing to purple-red when drought-stressed; *longitudinal nerves* 3 per face (central nerve the most pronounced), with widely spaced, openly longitudinally-anastomosing minor nerves between the main nerves; apices narrowed to a fine, subulate, straight, rigid, needle-like, dark brown, pungent tip; pulvinus much reduced, 0.3–0.6 mm long, represented by a narrow rim of yellowish tissue at base of lamina. *Gland* not prominent, 0.3–1.2 mm above pulvinus. *Inflorescences* simple, single within axils of phyllodes; *spikes* short (5–10 mm long when dry), light golden; *peduncles* 2–4 mm long, glabrous to sub-glabrous (hairs minute, straight, appressed and white); *receptacle* marked with short triangular projections (often appearing spiculate; most obvious when in flower), glabrous; *basal peduncular bract* single, often sub-persistent to anthesis, broadly ovate, *c.* 0.7 mm long, dark brown and glabrous except for minutely fimbriolate margin. *Bracteoles* peltate, early caducous, 0.7–0.8 mm long; claws narrowly linear; laminae broadly ovate, 0.7–0.8 mm across. *Flowers* 5-merous; *calyx* gamosepalous, 0.7–1 mm long (1/2–2/3 length of petals), sparsely puberulous, dissected for *c.* 1/4 its length, the lobes oblong, slightly inflexed and not thickened at apex; *petals* 1.3–1.5 mm long, ± nerveless, glabrous. *Pods* (few seen), narrowly oblong, 2.5–5.5 cm long, 4 mm wide, straight-edged or very shallowly constricted between seeds, very slightly raised over the seeds, thinly coriaceous, light brown (aging dark reddish brown following dehiscence), glabrous; marginal nerve not thickened. *Seeds* (few seen) longitudinal in the pods, obloid, 3 mm long, 2 mm wide, black with a satin lustre; *pleurogram* very obscure; *areole* extremely small (*c.* 0.2 mm long), open towards the hilum; *funicle* filiform, expanded into a non-convoluted, ± turbinate, thickened, creamy white *aril* that is sub-laterally positioned at end of seed. (Figure 1)



Western Australian Herbarium
PERTH 07577451

Acacia diallaga Maslin & Buscumb
Holotype C Buscumb
DETERMINAVIT: B.R. Maslin 30/12/2007
Western Australian Herbarium (PERTH)

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Acacia aff. subsessilis

Mimosaceae

In full flower.
Low hill, moderate slope. Red silty loam over granite/greenstone. Open mixed Acacia thicket with Allocasuarina dielsiana, Grevillea scabrida, G. subtiliflora, Chamelaucium sp. Yalgoo, Acacia acuminata, A. karina ms and Borya sphaerocephala.

Loc.: Karara Station

Lat. **Long.** GDA94

Coll. D. Coultas & C. Anderson AS–03 **Date:** 04/09/2007

Voucher: Gindalbie Metals Mt Karara Iron Ore 2007.

Dups. to
PERTH 07577451

According to D. Coultas (pers. comm.) this species grows on basalt, not granite/greenstone as given on label.
DETERMINAVIT: B.R. Maslin 6/2/2008
Western Australian Herbarium (PERTH)

Figure 1. Holotype of *Acacia diallaga* (*D. Coultas & C. Anderson* AS-03), scale = 5cm.

Characteristic features. Dense, spreading, much-branched *shrubs* 0.5–1.5(–3) m tall. *Phyllodes* narrowly elliptic to narrowly oblong-elliptic or lanceolate, asymmetric with upper margin shallowly convex and lower margin straight to shallowly concave, (3–)5–6(–7) mm wide, ± patent, glabrous, glaucous to sub-glaucous (green when young on new shoots), changing to purple-red when drought-stressed, with 3 main longitudinal nerves and openly longitudinally-anastomosing minor nerves between them, apex narrowed to a straight, rigid, needle-like, pungent tip; pulvinus much reduced. *Spikes* short (5–10 mm when dry); *peduncles* short (2–4 mm), glabrous to sub-glabrous; *basal peduncular bract* often persistent. *Bracteoles* peltate, early caducous, claws narrowly linear, laminae broadly ovate 0.7–0.8 mm across. *Flowers* 5-merous; *calyx* shortly dissected; *petals* 1.3–1.5 mm long. *Pods* narrowly oblong, 4 mm wide, straight-edged or very shallowly constricted between seeds, thinly coriaceous, light brown, glabrous; marginal nerve not thickened. *Seeds* obloid, 3 × 2 mm, black; *areole* extremely small (*c*. 0.2 mm long); *aril* sub-laterally positioned at end of seed.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 8 Aug. 2006, *D. Coultas & F. Obbens* GIND Opp 21 (PERTH); 13 Sep. 2006, *D. Coultas & K. Rodda* KR-3 (PERTH); 13 Sep. 2006, *C. Godden* GIND opp 29 (PERTH); 17 July 2007, *B.R. Maslin* 9126 (CANB, PERTH); 24 Apr. 2007, *Woodman Environmental Consulting s.n.* (PERTH 07534744).

Distribution. Acacia diallaga is known from a restricted area on Karara and Warriedar Stations in the Midwest Region of Western Australia, about 100 km east of Morawa, where it occurs in the vicinity of Blue Hill Range and Mt Mulgine. It has a patchy (discontinuous) distribution over a distance of about 30 km in an east-west direction and is locally common in the places where it grows. The general region in which the new species is found is relatively poorly collected, therefore it is possible that additional populations will be discovered. However, judging from current knowledge it is not expected that *A. diallaga* will be shown to have a very extensive geographic range.

Habitat. Acacia diallaga occurs in a semi-arid area with an annual rainfall of 250–300 mm, most of which falls between late autumn and early winter (May to July). It grows in skeletal, red, silty loam on the slopes, or occasionally crests, of low rocky (basalt) hills in open mixed *Allocasuarina* and *Acacia* thicket that includes *Acacia karina*, *Allocasuarina acutivalis* and *Grevillea* species (*G. scabrida* and *G. subtiliflora*).

Flowering and fruiting period. Because of the paucity of collections it is difficult to accurately determine the flowering and fruiting period for this new species; furthermore, it is likely that as with many other arid zone species of *Acacia* this one responds opportunistically to rainfall. Based on the material to hand plants were at full anthesis in early September and pods with mature seeds occurred in early to mid-December; it is estimated that flowering probably commenced around the middle of August. Field observations in 2007 showed that only few of the plants in the populations produced flowers or pods during that rather dry year.

Discovery. This new species was discovered by David Coultas and Frank Obbens in August 2006 while undertaking botanical surveys on Karara Station.

Conservation status. Acacia diallaga is recently listed as a Priority Two taxon according to the Department of Environment and Conservation's Conservation Codes for Western Australian Flora. Present knowledge shows the species as having a restricted and discontinuous distribution which is confined to Unallocated Crown Land on two former pastoral stations, Karara and Warriedar. These stations are now owned and managed by the Department of Environment and Conservation and are currently proposed conservation reserves. Some populations of *A. diallaga* may be under threat as they occur on areas covered by mining leases.

Etymology. The species name is based on the word diallagous which is derived from the Greek *diallage* (interchange). See discussion under *Notes* below .

Affinities. Acacia diallaga is most closely related to *A. subsessilis* on account of its basic phyllode nervature (eight longitudinal nerves in all, three on each face and one along each margin), short, spicate, simple inflorescences on short peduncles subtended by a single basal bract, peltate bracteoles with relatively large laminae, gamosepalous calyx and similar carpological characters (Chapman & Maslin 1999). Both species also have the ability to change their phyllode colour when stressed due to drought conditions (see under *Notes* below). These two species grow in close proximity to one another (the closest occurrences are about 20 km apart) but they are not know to be sympatric; both have restricted geographic ranges and share similar habitat preferences. The most obvious differences between *A. subsessilis* and *A. diallaga* are found in their phyllodes and pods as summarized in the key below. Although it could be argued that *A. diallaga* could be treated as a subspecies of *A. subsessilis*, its phyllode shape, size and colour differences are so striking that it is deemed appropriate to treat it as a distinct species; there are also differences in carpological features and distribution.

Key to *A. subsessilis* and *A. diallaga*

1. Phyllodes (3–)5–6(–7) mm wide, narrowly elliptic to narrowly oblong-elliptic or lanceolate, asymmetric with upper margin shallowly convex and lower margin straight to shallowly concave, glaucous to sub-glaucous (green on new shoots), anastomosing minor nerves present between the 3 main longitudinal nerves; pods 4 mm wide, not or scarcely constricted between the seeds; seeds 3 × 2 mm............................. **A. diallaga**

1: Phyllodes 0.7–1.2(–2) mm wide, acicular and narrowly linear to linear-triangular (widest phyllodes with a slight tendency towards narrowly elliptic), symmetrical, straight-edged, dull green (tinged bluish), anastomosing minor nerves absent or rare; pods 5–7 mm wide, shallowly to moderately constricted between the seeds; seeds 4–5 × 3–3.5 mm.. **A. subsessilis**

Notes. This species exhibits a change in colour of its phyllodes (from glaucous/sub-glaucous to purple-red) when water becomes limiting during periods of drought. Unless the phyllodes die they revert to their normal glaucous/sub-glaucous colour when conditions improve with the advent of rainfall. *Acacia subsessilis* does the same thing with the phyllodes changing from green to pale reddish, then reverting to green. Diallagy (adj. diallagous) is a new term coined by George (2002) to describe the ability of some plants to change the colour of their foliage and then reverse it according to weather conditions. Many examples of south-west Western Australian diallagous flora are beautifully illustrated in George (2002a).

Acknowledgements

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Acacia umbraculiformis (Leguminosae: Mimosoideae), a new species related to *A. quadrimarginea* from the Midwest Region of south-west Western Australia

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Abstract

Maslin, B.R. & Buscumb, C. *Acacia umbraculiformis* (Leguminosae: Mimosoideae), a new species related to *A. quadrimarginea* from the Midwest Region of south-west Western Australia. *Nuytsia* 18: 133–138 (2008). A new species common in the Midwest Region of Western Australia, *Acacia umbraculiformis* Maslin & Buscumb, is described and assigned to *Acacia* sect. *Juliflorae (*Benth.) C.Moore & Betche. Until recently this species had been confounded with *A. quadrimarginea* F.Muell.

Introduction

The new species described here, *Acacia umbraculiformis* Maslin & Buscumb, is referable to *Acacia* Mill. sect. *Juliflorae* (Benth.) C.Moore & Betche and is most closely related to *A. quadrimarginea* F.Muell. from which it is difficult to distinguish in the absence of pods. Indeed, until recently the new species had been confounded with *A. quadrimarginea* but was recognised as taxonomically distinct by Maslin (1998) who described and illustrated it as *A.* affin. *quadrimarginea. Acacia umbraculiformis* has been known at the Western Australian Herbarium (PERTH) for a number of years under the phrase name, *Acacia* sp. Murchison (B.R. Maslin 7331). Photographs of the new species are posted on the WorldWideWattle website at www.worldwidewattle.com and its distribution shown on *FloraBase* (Western Australian Herbarium 1998–).

The impetus for the present study is that some populations of *A. umbraculiformis* occur on a mining lease area located on Karara Station east of Morawa. It was therefore deemed desirable to formalise the name and to assess the conservation status of the new taxon in relation to public environmental reports that are currently under development for the area.

The boundaries of the two administrative regions referred to throughout this paper, the Midwest Region and Wheatbelt Region, are given in Department of Conservation and Land Management (2006).

Taxonomy

Acacia umbraculiformis Maslin & Buscumb, *sp. nov.*

Arbores bene-formatae obconicae 3–6(–7) m altae. Ramuli plerumque glabri. Phyllodia 5–11 cm longa, (2–)3–7.5 mm lata, linearia vel anguste elliptica, falcato-recurva, late effusa, nitida, glabra praeter statu juvenilis, atro-virentia, subtiliter multi-nervata, nervo marginali plerumque rubro-brunneo et resinoso. Pedunculi 2–8(–12) mm longi; spicae breviter cylindraceae vel obloideae vel sub-globulares, 3–10 mm longae (in sicco). Flores 5-meris; sepala ± libra vel 1/4–1/3 conjuncta. Legumina 5–16 cm longa, 6–9 mm lata, anguste oblonga vel linearia vel sub-moniliformia, in sectionibus non quadrangularia ut *A. quadrimarginea*, firme coriacea-crustacea vel sub-lignosa, atro-brunnea; nervus marginalis discretus, flavus vel pallide brunneus. Semina in legumine longitudinalia, obloidea vel ellipsoidea, grandia (5–10.5 mm longa, 5–6.5 mm lata; arillus parvus.

Typus: Koolanooka Hills, east of Morawa, Western Australia, 30 September 1990, *B.R. Maslin* 6602 (*holo*: PERTH 01162217; *iso*: CANB, K, MEL, NSW).

Acacia affin. *quadrimarginea sensu* Maslin (1998).

Acacia sp. Murchison (B.R. Maslin 7331), Western Australian Herbarium, in *FloraBase*, http://florabase.dec.wa.gov.au [accessed March 2008].

Shapely, obconic *trees* 3–6(–7) m tall, with spreading, flat-topped to sub-rounded crowns 3–6 m across, occasionally low spreading shrubs *c.* 1.5 m tall, single-stemmed or sometimes with up to 6 stems from the base, the stems often slightly crooked. *Bark* grey, longitudinally fissured and fibrous on stems. *Branchlets* terete (occasionally slightly angled at extremities), obscurely ribbed, glabrous except for new shoots, reddish brown (often partially covered with a light grey, ± flaking epidermis) ageing grey, sometimes yellowish at extremities. *New shoots* shiny-resinous with microscopic reddish resin hairlets embedded in a resin matrix at initiation, also with sparse to dense, silver, appressed, non-glandular hairs that become apparent as the shoot elongates, but these hairs (and the resin hairlets) soon lost. *Phyllodes* 5–11 cm long, (2–)3–7.5 mm wide, linear to narrowly elliptic, falcately recurved, wide-spreading, shiny, glabrous (except on new shoots), dark green; *parallel longitudinal nerves* numerous, fine, close together, the central one slightly more pronounced than the rest; *marginal nerve* mostly red-brown and resinous, sometimes yellow, occasionally scurfy white on surface; *apices* acute to acuminate and normally ± curved or occasionally sub-uncinate, innocuous; *pulvinus* 2–4 mm long. *Gland* situated on upper margin of phyllode 0–1.5 mm above pulvinus, inconspicuous. *Inflorescences* 1–4 within axil of phyllodes, simple or occasionally rudimentary, 1-branched racemes 0.5–1.5 mm long; *peduncles* 2–8(–12) mm long, sub-glabrous to densely appressed-hairy but often glabrous when in fruit, often with reddish resin hairlets intermixed with the short, straight, silvery-white non-glandular hairs when in flower; *spikes* shortly cylindrical to obloid or sub-globular, 3–10 mm long (when dry), golden yellow; buds slightly resinous. *Bracteoles* linear-spathulate, about 0.5–1 mm long, brown and ciliolate. *Flowers* 5-merous; *sepals* ± free to 1/4 or 1/3 united, 1/4 (or sometimes almost 1/2) the length of petals, oblong; *petals* 2 mm long, glabrous, 1/2 united, nerveless or obscurely 1-nerved. *Pods* 5–16 cm long, 6–9 mm wide, narrowly oblong to linear or sub-moniliform, occasionally moniliform, pendulous, rounded over seeds and straight-edged to moderately (rarely strongly) constricted between them, sub-straight to prominently curved, glabrous except with microscopic resin hairlets when very young, mature pods either non-resinous or possessing a thin, patchy layer of resin with ± sparse resin hairlets embedded within the matrix, firmly coriaceous-crustaceous to sub-woody, dark brown but sometimes light brown or yellowish at constrictions; *marginal nerve* discrete and slightly to moderately thickened, yellow or light brown. *Seeds* longitudinal in the pods, obloid to ellipsoid, large (5–10.5 mm long, 5–6.5 mm wide), dull or slightly shiny (satin lustre), dark brown to black, somewhat flattened (2.5–3 mm thick), normally shallowly concave at centre except areole area; *pleurogram* continuous, often slightly raised; *areole* elliptic, to 2.5 mm long, 1 mm wide, minutely pitted, brown (normally slightly lighter brown than rest of the seed); *funicle* short, expanded into small, terminal, cream to orange-cream (when dry) *aril*. (Figure 1)

Characteristic features. Shapely, obconic *trees* 3–6(–7) m tall, with spreading, flat-topped to sub-rounded crowns. *Branchlets* normally glabrous. *Phyllodes* 5–11 cm long, (2–)3–7.5 mm wide, linear to narrowly elliptic, falcately recurved, wide-spreading, shiny, glabrous at maturity, dark green; *parallel longitudinal nerves* numerous, fine and close together; *marginal nerve* mostly red-brown and resinous; *apices* acute to acuminate and normally ± curved, innocuous. *Inflorescences* 1–4 within axil of phyllodes; *peduncles* 2–8(–12) mm long, sub-glabrous to densely appressed-hairy, often glabrous in fruit; *spikes* shortly cylindrical to obloid or sub-globular, 3–10 mm long (when dry), golden. *Flowers* 5-merous; *sepals* ± free to 1/4 or 1/3 united. *Pods* 5–16 cm long, 6–9 mm wide, narrowly oblong to linear or sub-moniliform, occasionally moniliform, sub-straight to prominently curved, firmly coriaceous-crustaceous to sub-woody, dark brown; *marginal nerve* discrete and thickened, yellow or light brown. *Seeds* longitudinal, large (5–10.5 mm long, 5–6.5 mm wide), somewhat flattened; *arils* small.

Selected specimens examined. WESTERN AUSTRALIA: Between Mount Magnet and Cue, 12 July 1931, *W.E. Blackall* 77 (PERTH); City of Melbourne Mine, Yalgoo, 12 May 2004, *B. Hyland* 16803 (PERTH); Blue Hill Range, survey site WRHL07, Warriedar Station, 11 Oct. 2005, *A. Markey & S. Dillon* 3594 (PERTH); 6 km SE of Paynes Find on Maranalgo Road, 3 Oct. 1990, *B.R. Maslin* 6657 (PERTH); 7 km N Mt Magnet, 1 June 1994, *B.R. Maslin* 7331 (AD, MEL, NT, PERTH); 45 km NE of Kalannie, 8 Dec. 1996, *B.R. Maslin* 7561 (PERTH); 5 km due N of Mount Magnet on Great Northern

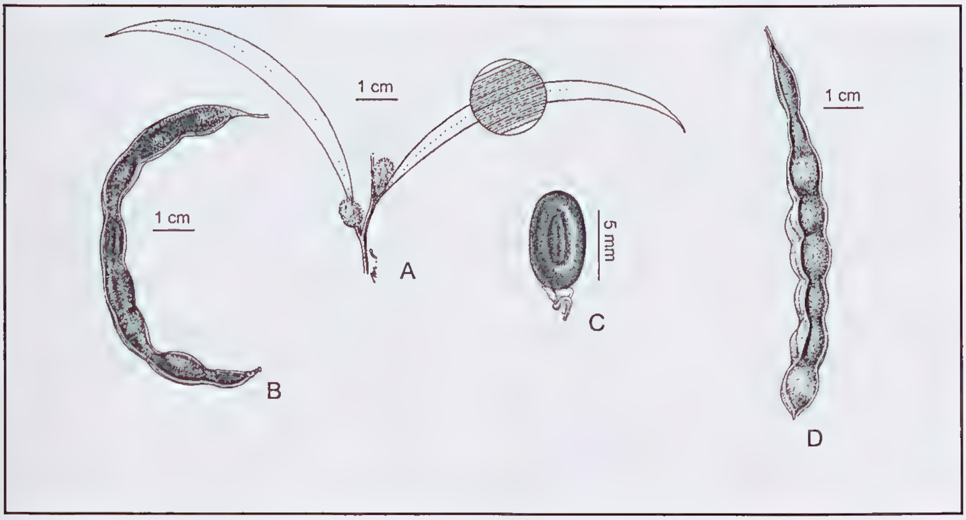

Figure 1 A – C. *Acacia umbraculiformis*. A – portion of branchlet showing distinctively recurved phyllodes; B – pod (note margins not flanged); C – seed. D. *Acacia quadrimarginea* – pod showing distinctively flanged margin. A – *W.E. Blackall* 77. B & C – *T. McKenzie* 3. D – *M. Blackwell* 77 (PERTH). Illustrations by M. Pieroni.

Highway, Oct. 1993, *T. McKenzie* 3 (PERTH); 35 km E of Perenjori, 14 Aug. 1986, *A.A. Mitchell* 1533 (PERTH); Reedy gold mine 60 km N Cue, 10 May 1996, *B.G. Muir* (PERTH); 1 km E of Woolgorong homestead, July 1994, *M. Officer* M09 (PERTH); near Remlap homestead, Washington Rocks, Koorda, 7 Sep. 1999, *R. Storer* 355 (PERTH).

Distribution. Acacia umbraculiformis occurs mostly in the Midwest Region of south-west Western Australia but extends to the northern extremity of the Wheatbelt Region. It ranges from near Cue and Mt Magnet south to near Koorda (this line forms the eastern boundary of its geographic range) and west to near Morawa and north of Mullewa to the vicinity of Pinegrove Station (about 150 km inland from Kalbarri). A few specimens to the northwest of Meekatharra may possibly be referable to *A. umbraculiformis* (see discussion under *Variation* below). Although populations of *A. umbraculiformis* are discontinuous (on account of its habitat specificity) the species is often locally abundant in the places where it occurs (Figure 2).

Habitat. Acacia umbraculiformis grows in rocky habitats, most commonly over granite but sometimes on banded ironstone or basalt; it has also been recorded from laterite in close proximity to granite. Soils range from sandy loam to hard sandy clay-loam. It is found mainly on hill crests and slopes, sometimes along creek lines, in mixed *Acacia* woodland and open *Acacia* shrubland (with, for example, *A. ramulosa* var. *ramulosa, A. tetragonophylla, A. aulacophylla*), and with *Borya* sp. ground cover when it occurs on granite.

Flowering and fruiting period. Acacia umbraculiformis appears to commence flowering in response

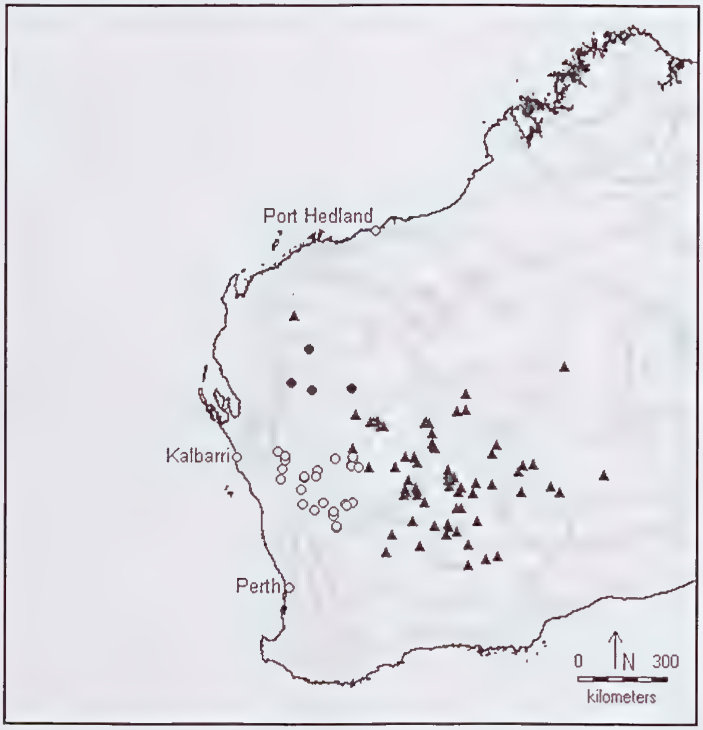

Figure 2. Distribution of *Acacia umbraculiformis* (○), *A.* ? *umbraculiformis* (● - see note under *Variation*) and *A. quadrimarginea* (▲).

to summer and early winter rainfall. The relatively few flowering specimens at hand show the species as flowering in February and April to July. However, because of the sporadic occurrence of rainfall within the geographic range of the species it is not expected that all plants will flower simultaneously during this period. Pods with mature seed have been collected between mid-September and mid-December.

Conservation status. Not considered rare or endangered.

Etymology. The specific epithet is derived from the Latin *umbraculum* (a parasol) and *forma* (shape) in allusion to both the habit of the plants and also to the characteristic wide-spreading, recurved phyllodes that are reminiscent of the curved outline of an open umbrella.

Common name. Western Umbrella Wattle.

Affinities. Until recently plants of *A. umbraculiformis* had been referred to its closest relative, *A. quadrimarginea*. These two species have a similar growth form and characteristically wide-spreading, falcately recurved, multi-nerved phyllodes with red-brown margins; they also possess short, golden spikes on short peduncles. However, *A. quadrimarginea* is readily recognised by its very distinctive pods which are quadrangular in section on account of having a distinct, vertical flange along each margin; this flange is perpendicular to and, importantly, extends beyond the face of the pod (Figure 1D). By contrast, the pods of *A. umbraculiformis* lack a marginal flange that extends beyond the face of the pod; its margins nevertheless possess a discrete, pale-coloured nerve (Figure 1B). Furthermore, the very young pods of *A. quadrimarginea* possess a distinct layer of shiny resin; at maturity these pods either retain the resin layer and/or possess a normally dense layer of resin hairlets (which give the pods an orange-red to dark reddish brown colour, at least when dry). The very young pods of *A. umbraculiformis* appear not to be shiny-resinous (although they do possess resin hairlets) while at maturity the pods are either not resinous or possess a thin, patchy layer of resin with ± sparse resin hairlets embedded within the matrix. Notwithstanding the above discussion we recognize that a more thorough investigation of resinosity in both immature and mature pods of the two species may be helpful in developing a better understanding of this character. Such a study should be based on fresh, living material (our observations were based on dry herbarium specimens). Apart from the pod differences, *A. quadrimarginea* often has longer flowering spikes (normally 10–20 mm long) than those of *A. umbraculiformis*. The geographic ranges of the two species abut in the Meekatharra – Mt Magnet region, with *A. umbraculiformis* distributed to the west of this line and *A. quadrimarginea* mostly to the east of it (and ranging eastwards to the Great Victoria Desert). It is not known if the two species are ever sympatric or whether or not they intergrade morphologically. The geographic ranges of the two species are shown in Figure 2.

Variation. Acacia umbraculiformis is relatively invariate although in the general vicinity of Mt Magnet township the phyllodes, on some plants at least, are consistently slender (at the lower end of the width range) while others from 'The Granites' (about 8 km north of Mt Magnet) are relatively short (at the lower end of the length range) and slightly less recurved than elsewhere. This variation appears not to be taxonomically significant, however, it is noted that Mt Magnet is located near the geographic boundary between the new species and its closest relative, *A. quadrimarginea.*

Additionally, there are a few flowering specimens from north-west of Meekatharra that may possibly be referable to *A. umbraculiformis*, but pods are needed to confirm their identification. These specimens can be arranged in two groups: Group 1 has narrow phyllodes similar to those found on plants from near Mt Magnet (e.g. *R.J. Cranfield* 5346 from Erong Springs Station and *B.R. Maslin*

5195 from Cobra Station); Group 2 has phyllodes that are slightly shorter (to 4 cm long) and more obtuse than normal for *A. umbraculiformis* (e.g. *R.J. Cranfield* 5622 from Yarlarweelor Station and *B.R. Maslin* 5007 from east of Gascoyne Junction).

Rank. Current evidence suggests that, apart from geographic distribution, it is pod morphology (and to a lesser extent, spike length) that enables *A. umbraculiformis* and *A. quadrimarginea* to be reliably distinguished. While it could be argued that these two entities might be treated as infraspecific taxa of *A. quadrimarginea*, the pod differences are very obvious and are judged as being taxonomically significant. It is therefore considered both pragmatic and taxonomically appropriate to recognize the taxa as distinct species. Future studies, especially molecular genetics and pod anatomy, may provide evidence necessitating a reassessment of this rank.

Cultivation. Although it is not known in cultivation this hardy, long-lived species with its attractive growth form could be useful in amenity plantings as a provider of shade for arid and semi-arid areas. In nature it is probably slow-growing but with supplementary water under cultivation it may attain acceptable growth rates.

Acknowledgements

We wish to thank Gindalbie Metals Ltd for their generous financial and other support of this study. Paul Wilson is thanked for providing the Latin description and Margaret Pieroni for the drawings that are presented in Figure 1.

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New taxa of *Acacia* (Leguminosae: Mimosoideae) and notes on other species from the Pilbara and adjacent desert regions of WesternAustralia

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Abstract

Maslin, B.R. & van Leeuwen, S. New taxa of *Acacia* (Leguminosae: Mimosoideae) and notes on other species from the Pilbara and adjacent desert regions of Western Australia. *Nuytsia* 18: 139–188 (2008). Preparatory to publishing books on the *Acacia* Mill. flora of the Pilbara region, 10 new species (*A. bromilowiana* Maslin, *A. fecunda* Maslin, *A. leeuweniana* Maslin, *A. minutissima* Maslin, *A. subcontorta* Maslin, *A. subtiliformis* Maslin, *A. trudgeniana* Maslin, *A. robeorum* Maslin, *A. thoma* Maslin and *A. walkeri* Maslin) and two new subspecies (*A. catenulata* C.T.White subsp. *occidentalis* Maslin and *A. steedmanii* Maiden & Blakely subsp. *borealis* Maslin) are described. *Acacia coriacea* DC. is now more narrowly circumscribed to include subsp. *coriacea* and subsp. *pendens* R.S.Cowan & Maslin only, while the former *A. coriacea* subsp. *sericophylla* (F.Muell.) R.S.Cowan & Maslin has been reinstated as a distinct species (*A. sericophylla* F. Muell.). Notes on the variation in Western Australian plants of *A. drepanocarpa* F.Muell. are provided. *Acacia bromilowiana*, *A. fecunda* and *A. subtiliformis* are Priority Three taxa and *A. leeuweniana* is a Priority One taxon according to the Department of Environment and Conservation's Conservation Codes for the Western Australian Flora.

Introduction

The 12 new taxa of *Acacia* Mill. described here are the result of study conducted in the Pilbara region over the past five years. The aim of this study is the production of an identification guide to the *Acacia* flora of the Pilbara region (Maslin & van Leeuwen, in prep.) in order to facilitate the appreciation and use of these species in land management, nature conservation, rehabilitation and sustainable utilisation. *Acacia* species dominate many Pilbara ecosystems and apart from being important in nature conservation programs and in mine site and other land rehabilitation programs, some provide a source of fodder for the pastoral industry especially during drought times while others have ethnobotanical and cultural significance to the local indigenous people of the region.

As used here the term Pilbara Region corresponds to the Fortescue Botanical District as defined by Beard (1980), which essentially conforms to the 193,105 km^2 Pilbara Region as defined in the Interim Biogeographic Regionalisation for Australia (Environment Australia 2000). Perhaps the most well-known and distinctive natural feature of the Pilbara is the Hamersley Range which is a series of ranges, ridges, hills and plateaux extending from near Pannawonica in the west to east of Newman. The Hamersley Range contains Western Australia's highest mountain, Mt Meharry (1,245 m), and is made up of numerous small ranges such as the Ophthalmia, Hancock, Western Packsaddle, Lowloit and Werribee Ranges.

The region is a mountainous landscape underlain by the Archaean granites of the Pilbara Block. In the north the region comprises undulating granitic and basaltic ranges (e.g. the Chichester Range) interspersed by extensive alluvial river flats and colluvial plains of decomposing basalt and granite. In the south the Pilbara Block is overlain by Proterozoic sedimentary banded ironstone ranges and plateaux (e.g. the Hamersley Range) which are heavily dissected by gorges and drainage features and accompanied by basalt and dolerite intrusions. In the west the region comprises an extensive alluvial plain (e.g. the Roebourne Plain) supporting river flats while in the east the mountainous topography and rocky pediments acquiesce to the rolling dunefield and sand plains of the Little Sandy and Great Sandy Deserts. The soils of the region are predominately red pediments that are skeletal, shallow, stony, underlain by a hardpan and usually covered by a surface mantle of pebbles and cobbles. Heavy clays and gilgais are associated with some river flats, drainage basins and basaltic plains while alluvial deposits predominate on the coastal plain and associated river deltas and flats. Aeolian sand plains and small isolated dunes occur along the eastern and southern fringes of the region.

The climate of the Pilbara is arid tropical with highly variable summer rainfall, particularly in the south. Annual rainfall averages 250–300 mm which is up to 12 times less than evaporation (Bureau of Meteorology 2006). Cyclonic activity is significant, with several systems affecting the coast and hinterland annually.

The vegetation of the Pilbara is best described as a tree or shrub steppe where *Acacia* and *Triodia* are the dominant elements (Beard 1990). Eucalypts are also a conspicuous element in many communities. The vegetation is complex and varied and influenced noticeably by geology and fire history. Grasslands range from extensive annual bunch grass (*Aristida*, *Enneapogon*) flats or perennial tussock grass (*Eriachne*, *Chrysopogon*) plains on the coast through to Mitchell Grass (*Astrebela*) flats on some river washes to rolling hummock grass ('Spinifex' - *Triodia*) plains on stony hills, ranges and aeolian sand plains. Shrublands dominate the Pilbara landscape with *Acacia* and *Senna* species being the obvious elements although to the south of the region *Eremophila* species become conspicuous. Occasionally, samphire heaths (*Tecticornia*, *Frankenia*, *Rhagodia*) dominate, especially along the mangal fringed coast and on large internal drainage basins (e.g. Fortescue Marsh). Woodlands, in particular Mulga (*Acacia aneura sens. lat.*) woodlands, are dominant throughout the Hamersley Range and into the Fortescue Valley whereas *Eucalyptus* woodlands (*E. camaldulensis*, *E. victrix*) fringe most drainage features in the region and where surface water is plentiful forests of River Red Gum (*E. camaldulensis*) and Cadjeput (*Melaleuca argentea*) are a common occurrence. Uniformly sparse occurrences of eucalypts (*Eucalyptus leucophloia*, *Corymbia hamersleyana*) occur across the landscape particularly as emergent elements from 'Spinifex' grasslands. Unusual vegetation types include palm (*Livistona alfredii*) communities on freshwater springs and mallee shrublands on the summits of mountains within the Hamersley Range. The Pilbara region has a known flora approaching 2,100 taxa (Paczkowska & Chapman 2000). Floristically the region has a typically arid zone flora with most eremaean elements being present, in particular *Acacia*, *Senna*, *Sida*, *Hibiscus*, *Ptilotus* and a preponderance of Poaceae, Malvaceae, Amaranthaceae and Goodeniaceae. Floristic elements of the tropical north (*Brachychiton*, *Terminalia*) and the mesic south (*Daviesia*, *Thysanotus*, *Hibbertia*) are also present. The Pilbara is phytogeographically important for being within the transition zone from tropical grasslands to the north and *Acacia* shrubland/woodlands to the south (*Triodia - Acacia* line – Beard 1975). This feature is exemplified by the preponderance of 'Spinifex' and wattles in the region and in the Hamersley Range it is exemplified by the juxtaposition of extensive fire sensitive Mulga woodland underlain by a fire-prone 'Spinifex' understorey.

The Pilbara represents a secondary centre of species richness for *Acacia* in Western Australia (Hnatiuk & Maslin 1988) with 118 taxa recorded for the region (Web reference 1). This number includes 83 species (some comprising two or more infraspecific taxa), 21 hybrids or putative hybrids and seven taxa of uncertain taxonomic status (many of these are known from only a single gathering and may well represent hybrids).

Twelve new taxa of *Acacia* from the Pilbara are described below as a result of the present study. The numbers of species (excluding hybrids and taxa of uncertain status) known to occur in the Pilbara has increased by about 50% over the past 25 years; in 1982 there were 54 recorded for the region (Maslin 1982). A more detailed discussion of the Pilbara *Acacia* flora will be published elsewhere (Maslin & van Leeuwen, in prep.).

It should be noted that the type of *Acacia* was recently changed from the African/Asian species *A. scorpioides* (L.) W.F.Wight (=*A. nilotica* (L.) Delile), to the Australian species *A. penninervis* DC. (McNeill 2006). One of the consequences of this action is that the name *Acacia* subg. *Acacia* now applies to the 'Australian group' of wattles formerly called *Acacia* subg. *Phyllodineae* DC. (Maslin 2008). Similarly the former section *Phyllodineae* DC. becomes section *Acacia*. This new nomenclature is adopted in the present paper.

Photographs of all the taxa described here are presented on the WorldWideWattle website at www.worldwidewattle.com. A key to the Pilbara acacias, accompanied by descriptions, illustrations and photographs will be presented in Maslin and van Leeuwen (in prep.).

Taxonomy

Acacia bromilowiana Maslin, *sp. nov.*

Arbores vel frutices erecti gangliiformes 2–5(–6.5) m alti, aliquando ad 12 m; *caules* principales 1 vel 2, sub-recti vel aliquantum curvati, raro (Balfour Downs Station) tholiformes et effusi. *Cortex* longitudinaliter fisuratus, fibrosus (in laciniis longis exutus). *Ramuli* glabri, rubelli interdum pruinosi. *Surculi novi* strato micro-pilis densis ferruginis ornati. *Phyllodia* asymmetricaliter lanceolata vel anguste elliptica, (8–)10–14(–18) cm longa, (13–)20–40(–45) mm lata, coriacea, griseo-viridia aut glauca (surculis novis virentibus), subtilitissima multi-striata, anastomosibus paucis; *pulvinus* saepe obscure rubellus. *Inflorescentiae* plerumque racemorum brevi-binatorum, 5–15 mm longae; *pedunculi* 5–15(–20) mm longi, glabri; *spicae* 25–45 mm longae, vivide pallido aureae, dense floriferae. *Flores* 5-meri; *calyx* longitudine 2/5–3/4 corollae, breviter dissectus; *petala* glabra. *Legumina* (pauca visa) anguste oblonga, plana, 2–7 cm longa, 7–10 mm lata, papyracea, glabra, luteola. *Semina* (pauca visa) in leguminum transerse posita; *funiculum* applanatum, cremeo album; *arillus* parvus, sub-terminalis.

Typus: Hamersley Range, Western Australia [precise locality withheld for conservation reasons], 3 July 2006, *E. Thoma* 1100 (*holo*: PERTH 07418930; *iso*: CANB, G, K, MEL, NSW).

Acacia sp. (M.E.T. 584), in Trudgen, M.E. (1984).

Gnarled and normally erect *shrubs* or *trees* commonly 2–5(–6.5) m tall with diameter breast height to *c.* 12 cm, occasionally (in very favourable sites) 10–12 m tall with diameter breast height to *c.* 30 cm, with 1 or 2 sub-straight to somewhat crooked main stems that branch at *c.* 1 m or more above the ground, the crown dense, rarely (on Balfour Downs Station) domed sprawling shrubs 1–2 × 3–4 m with crown extending to the ground, sometimes clonal (see *Variation* below). *Bark* grey to black, longitudinally fissured and fibrous (peeling off in long strips) on main stems and upper branches. *Branchlets* terete, very obscurely ribbed, glabrous, reddish, sometimes pruinose. *New shoots* invested with a dense layer of ferruginous microscopic hairs when first initiated but soon becoming glabrous and green or lightly pruinose. *Phyllodes* asymmetrically lanceolate to narrowly elliptic, broadest near or below the middle, lower margin ± straight to shallowly concave, upper margin convex, (8–)10–14(–18) cm long, (13–)20–40(–45) mm wide, coriaceous, straight to shallowly falcately recurved, slightly undulate when very broad, glabrous, grey-green to sub-glaucous or glaucous (except young shoots); very finely longitudinally multistriate, the *nerves* parallel with a few anastomosing, close together, 3–5 slightly more pronounced than the rest and none confluent with the margin at the base; *apices* sub-acute to obtuse, not pungent; *pulvinus* (2–)3–6(–8) mm long, smooth or shallowly transversely to longitudinally wrinkled, normally with a few low-profile longitudinal ridges when dry, dull reddish or reddish brown (? sometimes yellow – see discussion below). *Gland* inconspicuous, situated on upper margin of phyllode 0–2 mm above pulvinus. *Inflorescence* normally a single binate raceme 5–15 mm long, a few rarely with 4 spikes and to 35 mm long, sometimes growing out at apex with subsequent inflorescences single and simple (i.e. not racemose) within axil of phyllodes, raceme axes compressed and glabrous; *peduncles* 5–15(–20) mm long, glabrous; *receptacles* glabrous, sometimes longitudinally rugose when dry, invested with short emergent processes near flower scars when in fruit (but only one fruiting sample seen); *spikes* 25–45 mm long and 9–10 mm wide, bright light golden, flowers close together to form a dense spike. *Bracteoles* 1–1.5 mm long, claws linear, ciliolate and pale coloured, laminae ovate, inflexed, small (*c.* 1 mm long), light brown and acute to apiculate. *Flowers* 5-merous, 2 mm long; *calyx* 2/5–3/4 length of corolla, shortly dissected into oblong, inflexed lobes which are thickened abaxially, the tube sparsely to moderately puberulous, truncate at base; *petals* glabrous, nerveless. *Pods* (few seen) narrowly oblong, flat, scarcely raised over seeds, straight-edged or very slightly constricted between seeds, 2–7 cm long, 7–10 mm wide, papery, glabrous, yellowish, nerveless or very obscurely nerved. *Seeds* (few seen) transverse or longitudinal in the pods, ovoid, 3.5–4 mm long, 2.5–3 mm wide, slightly shiny, brown; *pleurogram* very indistinct, widely 'u'-shaped; *funicle* flattened, creamy white, expanded into a small sub-terminal *aril*. (Figure 1)

Characteristic features. Gnarled, normally erect *shrubs* or *trees* with 1 or 2 sub-straight to somewhat crooked main stems, rarely (on Balfour Downs Station) domed and sprawling shrubs. *Bark* longitudinally fissured and fibrous (peeling in long strips) on main stems and upper branches. *Branchlets* glabrous, reddish, sometimes pruinose. *New shoots* with a dense layer of ferruginous microscopic hairs when first initiated. *Phyllodes* asymmetrically lanceolate to narrowly elliptic, broad (normally 2 cm or more wide), coriaceous, grey-green to glaucous (green on new shoots), very finely multistriate with few anastomoses; *pulvinus* mostly 3–6 mm long, often dull reddish or reddish brown, smooth or finely wrinkled. *Inflorescences* normally short binate racemes 5–15 mm long; peduncles 5–15(–20) mm long glabrous; spikes long and densely flowered. *Pods* (few seen) narrowly oblong, flat, papery, glabrous, yellowish. *Seeds* (few seen) transverse or longitudinal in the pods, brown; *funicle* flattened, creamy white, expanded into a small sub-terminal *aril*.

Selected specimens examined. WESTERN AUSTRALIA [precise localities withheld for conservation reasons]: Hamersley Range: 4 Oct. 2006, *B. Bromilow s.n.* (CANB, K, MEL, NSW, PERTH 07375107); 2 June 2006, *B.R. Maslin* 8784 (PERTH); 6 July 2006, *E. Thoma* 1024 (AD, NT, PERTH); 1 Aug. 2006, *E. Thoma* 1025 (PERTH); 14 July 1997, *M.E. Trudgen* 16163 (PERTH) and 16164 (CANB, K, MEL, NSW, NY, PERTH); 23 May 1991, *S. van Leeuwen* 762 (PERTH); 16 Aug. 1992, *S. van Leeuwen* 1300 (PERTH); 1 Aug. 1998, *S. van Leeuwen* 3571 (PERTH); 6 Aug. 1998, *S. van Leeuwen* 3643 (PERTH); 1 Oct. 1998, *S. van Leeuwen* 4231 (PERTH). Balfour Downs Station: 29 June 1996, *A.L. Payne* PRP 1371 (PERTH); 13 Aug. 2006, *B.R. Maslin* 8871 (MEL, PERTH).

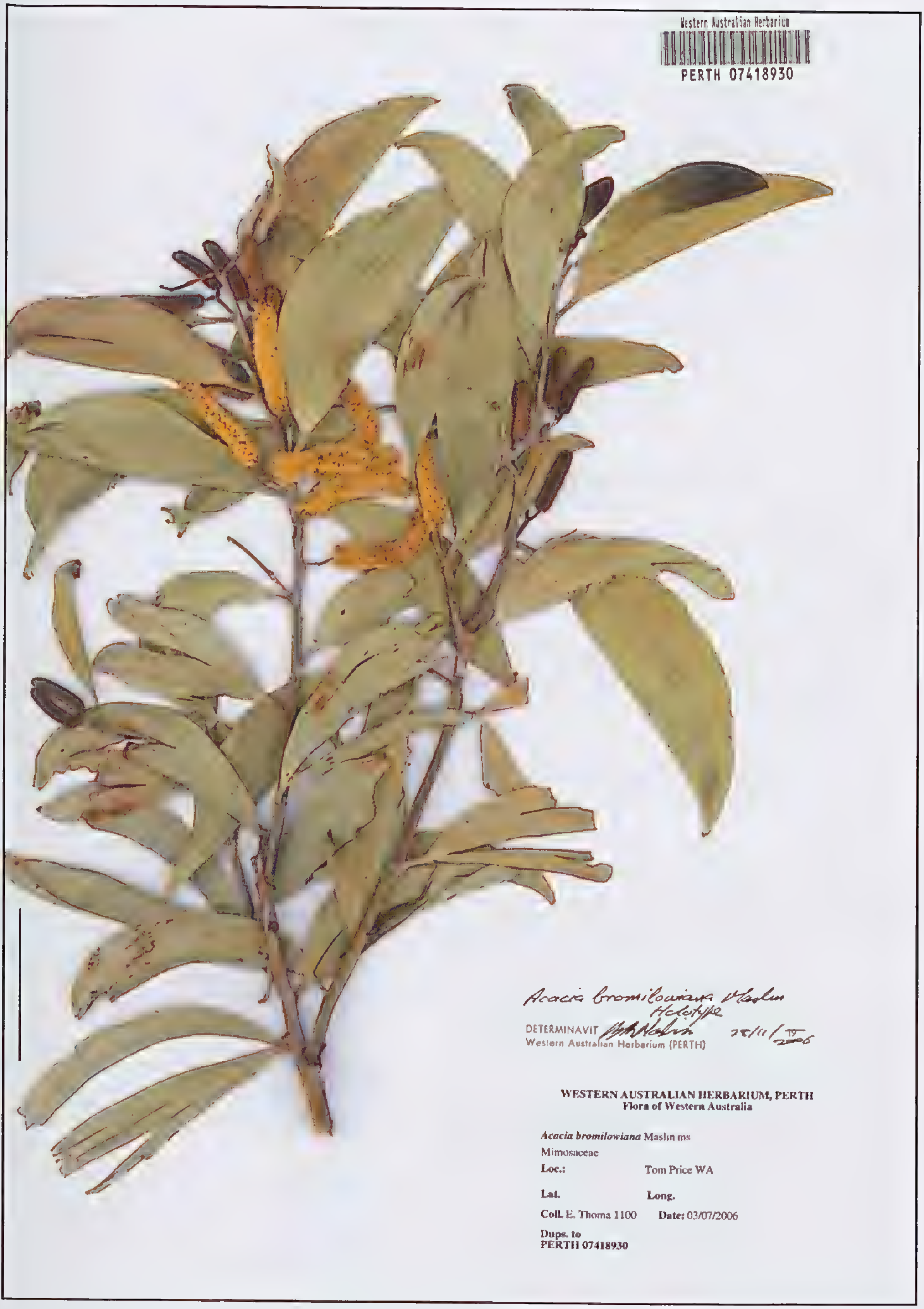

Western Australian Herbarium
PERTH 07418930
Acacia bromilowiana Maslin
Holotype
DETERMINAVIT
Western Australian Herbarium (PERTH)
28/11/2006
WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia
Acacia bromilowiana Maslin ms
Mimosaceae
Loc.: Tom Price WA
Lat.
Long.
Coll. E. Thoma 1100
Date: 03/07/2006
Dups. to
PERTH 07418930

Figure 1. Holotype of *Acacia bromilowiana* Maslin (PERTH 07418930), scale = 5 cm.

Distribution and ecology. Known only from a few disjunct hilltop populations in the Hamersley Range where it extends from Tom Price through Ophthalmia and Hancock Ranges to Newman, and also from Balfour Downs Station, about 150 km north-east of Newman. A similar disjunction between the Hamersley - Ophthalmia Ranges and the Balfour Downs area occurs also in *A. subcontorta* Maslin and *A. catenulata* C.White subsp. *occidentalis* Maslin (see below). *Acacia bromilowiana* grows in skeletal stony loam typically high in the landscape. The Hamersley Range populations occur on steep slopes, ridge tops and breakaways (often in gullies and sheltered places) that comprise a substrate of banded ironstone (Hamersley Group – Brockman Iron Ore Formation) or massive basalts (Jerrinah Formation – Fortescue Group). These localities are dominated by very open low eucalypt woodlands (*Eucalyptus leucophloia, Corymbia hamersleyana*) over 'Spinifex' (e.g. *Triodia pungens, T. wiseana*). On Balfour Downs Station the species occurs as a series of disjunct populations over a ten kilometre range where it forms monotypic stands in skeletal loamy soil, on the dissected slopes of low ferruginous breakaways of the Billygoat Land System (Van Vreeswyk *et al.* 2004). In these Balfour Downs populations there is limited litter or 'Spinifex' between plants and thus they are afforded protection from fire which probably accounts for their presumed old age.

Flowering and fruiting period. Flowering commences in early July and continues until about mid-August. A number of collectors (e.g. Trudgen & Casson 1998) have commented on the large numbers of inflorescence spikes found on the ground under the plants during the flowering period, the peduncles having abscised from the racemes soon after anthesis commences. Mature pods occur from about September to October (few pods have been seen which makes it difficult to accurately determine the fruiting phenology).

Conservation status. Listed as Priority Three under the Department of Environment and Conservation's (DEC) Conservation Codes for Western Australian Flora (Atkins 2008).

Etymology. This species is named for Robert (Bob) Neil Bromilow, who, as Technical Officer to Stephen van Leeuwen (see *A. leeuweniana* below) provided excellent field and laboratory assistance over 17 years in the Pilbara. The support provided by Bob was pivotal in the completion of several large scale botanical surveys, the most noteworthy being the 'Botanical Survey of Hamersley Range Uplands', 'Biological Survey of the South-western Little Sandy Desert' and the current 'Pilbara Biological Survey'. Bob was also instrumental in maintaining and curating the collection at the now disbanded Pilbara Regional Herbarium in Karratha.

Common name. Bromilow's Wattle (suggested new common name).

Affinities. Acacia bromilowiana belongs to *Acacia* sect. *Juliflorae* (Benth.) C.Moore & Betche and appears to be most closely related to *A. hamersleyensis* Maslin with which it often grows. *Acacia hamersleyensis*, however, is often a multi-stemmed shrub (oldest plants rarely assuming a gnarled spreading habit somewhat similar to some forms of *A. bromilowiana*) which is readily distinguished from the new species by its simple (not racemose) inflorescences, hairy peduncles and pods (glabrous in *A. bromilowiana*), sericeous new shoots with pale yellow or silvery appressed hairs (the distinctive layer of dense, red-brown minute hairs that occur on young new shoots of *A. bromilowiana* is absent) and its seeds which are oblique (not transverse or longitudinal) in the pods and which have a band of dull yellow tissue surrounding the small central areole (this band of tissue is absent in *A. bromilowiana*). Other characters useful in recognizing *A. hamersleyensis* include its yellowish to light brown or orange branchlets (seemingly always reddish in *A. bromilowiana*), normally narrower phyllodes which only rarely exceed 20 mm in width and which never have anastomosing nerves (careful examination of phyllodes at ×10 magnification or higher is needed to observe the relatively few anastomoses that occur on the phyllodes of *A. bromilowiana*), its commonly shorter peduncles (3–7 mm long) and its often longer (mostly (4–)5–10 mm long), more slender and more coarsely wrinkled, orange or yellow pulvinus.

Variation. Acacia bromilowiana shows considerable variation in its growth characteristics. In the Hamersley Range it is normally an erect shrub or small tree 2–5(–6.5) m tall with one, or sometimes two, rather crooked main stems and a dense crown that occupies the upper half of the plant; in the Hancock Range, however, plants from a small, sheltered gully attained a height of 12 m. It is assumed that this tall stature has resulted from the population escaping the ravages of fire for a considerable length of time. On Balfour Downs Station (at the eastern extremity of the known geographic range of the species) the plants are similarly protected from fire (see *Distribution and ecology* above) but in this case they grow as low-domed shrubs 1–2 m tall, with thick, gnarled and twisted trunks and spreading crowns that extend to the ground.

On most plants the phyllodes vary from 2–4 cm wide, however, on one gathering from the Ophthalmia Range (*S. van Leeuwen* 4231) they were atypically narrow, ranging down to about 13 mm wide. Some collectors have noted that on living plants the pulvinus is reddish in colour (but normally drying brownish), however, on some herbarium material the pulvinus is yellowish.

Judging from field observations it appears that most (perhaps all) occurrences of *A. bromilowiana* in the Hamersley Range represent a series of clonal populations. To test this notion a small, preliminary genetic investigation using RAPD markers was undertaken by M. Byrne (pers. comm.), based on plants collected by M. Trudgen from two populations near West Angelas in the Hamersley Range. The results from this study showed there to be no genetic variation within either of the populations, suggesting that they were indeed clonal clumps. However, plants on Balfour Downs Station appear not to be clonal, although they have not been tested genetically.

Acacia catenulata C.T.White subsp. **occidentalis** Maslin, *subsp. nov.*

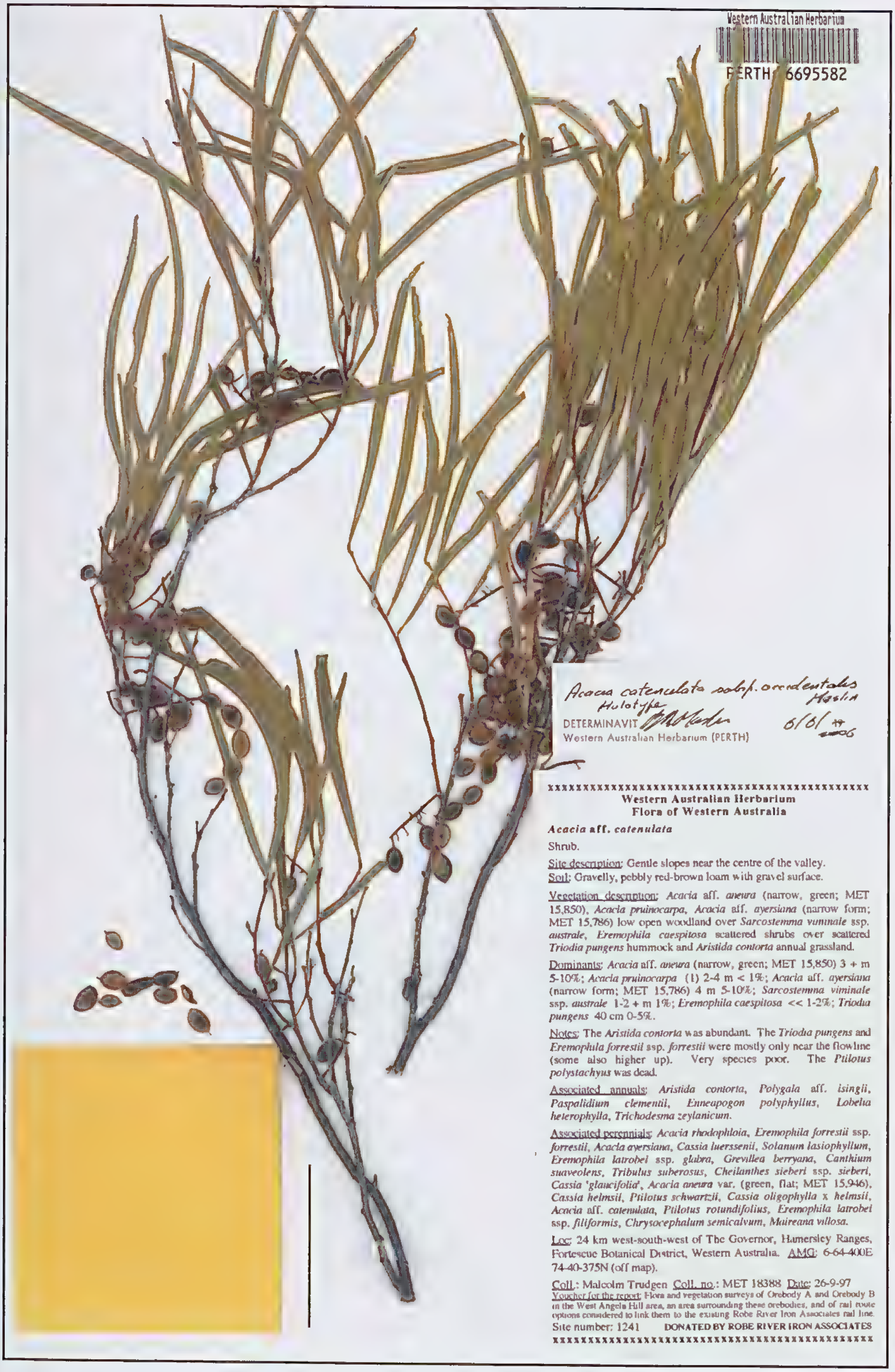
Frutices grandi rotundati, in statu maturo abores obconicae vel effusae et bene formatae 3–8 (–10) m altae, ab subsp. *catenulatae* imprimis differt: truncis non striatis, surculis novis primo dense argillaceis vel pallido luteo sericeis, indumento sparso in statu aetate. In regionis Pilbara, Western Australia, limitato.

Typus: 24 km west-south-west of The Governor, Hamersley Ranges, 26 September 1997, *M. Trudgen* 18388 (*holo*: PERTH 06695582; *iso*: K).

Dense, rounded large *shrubs* maturing to obconic or spreading shapely *trees* 3–8(–10) m tall, with a single trunk or having a few trunks (up to about 4) arising from ground level, trunks (and branches) not fluted, with wide-spreading (patent to ascending) lateral branches along main trunks from near ground level (these branches persist, even after they have died, until the plants are very mature), the crowns bushy, often rounded and up to 3–4(–5) m across. *Bark* mid-grey to black, longitudinally fissured and fibrous on main trunks, smooth on branches. *Branchlets* light brown or orange extremities, glabrous except minutely appressed-hairy at ends of at least the young branchlets (observe at × 10 magnification), the hairs straight, silvery white and becoming sparser with age. *New shoots* densely sericeous, the hairs silvery or pale citron when first initiated, silvery and becoming sparser with age. *Phyllodes* variable, narrowly elliptic or oblong-elliptic to linear-elliptic, occasionally narrowly lanceolate, (4.5–)6–11 cm long, (3–)4–8(–12) mm wide (the shortest and broadest phyllodes appear to occur on young plants), not rigid, wide-spreading, sometimes straight but more typically shallowly to moderately falcately recurved, occasionally imperfectly sigmoid, invested with a sparse to moderately dense layer of minute (difficult to see without magnification), closely appressed, straight, silvery-white hairs which become progressively sparser with age (absent from oldest phyllodes), mid- to dark-green (with a slight silvery sheen) to distinctly sub-glaucous or dull greyish green; very finely multi-nerved, the *nerves* longitudinal, parallel (longitudinal anastomoses very infrequent) and close together, the midrib and sometimes a nerve on either side of it slightly more pronounced than the rest; *marginal nerve* not prominent, very narrow, yellow or occasionally light brown (at least when dry) and not resinous; *apices* acute; pulvinus 2–3 mm long, finely transversely wrinkled and yellow to brown when dry. *Gland* very obscure, situated on upper margin of phyllode 0–2 mm above pulvinus, lamina not or only slightly swollen about the gland. *Inflorescences* simple or rudimentary racemes, *peduncles* normally 2 per axil with a rudimentary vegetative bud within their angle at anthesis, 2–7 mm long, moderately to densely hairy, sometimes glabrous in fruit, hairs appressed or ± spreading; *receptacle* glabrous or sparsely puberulous (hairs white, ± patent); *spikes* 8–15 mm long (when dry), presumably golden, the flowers rather close together. *Bracteoles* sub-peltate. *Flowers* 5-merous, small; *sepals* linear-spathulate, free to base, about half the length of petals; *petals* 1.2 mm long, glabrous, very obscurely 1-nerved; *ovary* densely silvery appressed-hairy. *Pods* flattened (scarcely raised over the seeds), deeply constricted between seeds, fragile and readily breaking into 1-seeded oblong-elliptic articles at the constrictions, 20–50 mm long, 4–6(–8) mm wide, thinly coriaceous-crustaceous, glabrous or sometimes minutely appressed hairy at constrictions, openly reticulate (nerves raised, at least when dry), stipitate. *Seeds* longitudinal in the pods, ellipsoid to obloid-ellipsoid, 3.5–5 mm long, 2–3 mm wide, flattened (*c.* 1 mm thick), dark brown, seed coat thin; *areole* very small and inconspicuous; *funicle* filiform, ± exarillate or expanded into a very small, terminal *aril*. (Figure 2)

Characteristic features. Dense, rounded large *shrubs* maturing to obconic or spreading shapely *trees*, trunks not fluted, with wide-spreading lateral branches along main trunks from near ground level and persisting until plants quite mature. *Branchlets* glabrous except minutely appressed-hairy at ends of at least the young branchlets. *New shoots* densely sericeous (hairs silvery or pale citron) when first initiated. *Phyllodes* narrowly elliptic or oblong-elliptic to linear-elliptic, occasionally narrowly lanceolate, sometimes straight but more typically shallowly to moderately falcately recurved, occasionally imperfectly sigmoid, not rigid, microscopically appressed-hairy but ageing glabrous, very finely longitudinally multistriate with nerves parallel and close together, marginal nerve not pronounced. *Inflorescences* simple or rudimentary racemes; *peduncles* short (2–7 mm long), hairy (except sometimes glabrous when in fruit); *spikes* short (8–15 mm long). *Sepals* free. *Pods* deeply constricted between seeds and readily breaking into 1-seeded, oblong-elliptic articles at the constrictions, flat, thinly coriaceous-crustaceous, glabrous (sometimes minutely appressed hairy at constrictions), openly reticulate. *Seeds* flat, seed coat thin and not especially hard, the *funicle* filiform and not or scarcely expanded into an *aril*.

Selected specimens examined. WESTERN AUSTRALIA: west of Rhodes Ridge, 10 Feb. 1988, *J.E.D. Fox* A7005 (PERTH); 31 km E of Newman on road to Port Hedland, 28 June 1993, *B.R. Maslin* 7234 (MEL, PERTH); Ethel Creek Station, 31 May 2004, *B.R. Maslin* 8527 (PERTH); Balfour Downs Station, 1 June 2004, *B.R. Maslin* 8536 (PERTH); 25.1 km NW of Newman (on new Great Northern Highway, Ophthalmia Ranges), 22 Oct. 1988, *L. Thomson* LXT 1130E (PERTH); 13.25 km SSW of Mt Hilditch, Hamersley Ranges, 27 Sep. 1999, *M. Trudgen* MET 18384 (PERTH); 2.5 km SSW of The Governor, 4.6 km NE of Coondewanna Hill, 18 Sep. 1991, *S. van Leeuwen* 1050 (NSW, PERTH); 2.7 km SSW of The Governor, 9 km SW of Mt Robinson, 5 km NNW of Padtherung Hill, 14 May 1992, *S. van Leeuwen* 1178 (K, PERTH); Ore Body 24, Ophthalmia Range, eastern end of Hamersley Range, 20.9 km E of Mt Newman, 27.6 km W of Shovelanna Hill, 15 km NNW of Newman Airport, 20 Aug. 1998, *S. van Leeuwen* 3831 (CANB, PERTH).



Western Australian Herbarium
PERTH 6695582

Acacia catenulata subsp. occidentalis Maslin
Holotype
DETERMINAVIT 6/6/06
Western Australian Herbarium (PERTH)

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Western Australian Herbarium
Flora of Western Australia

Acacia* aff. *catenulata

Shrub.

Site description: Gentle slopes near the centre of the valley.
Soil: Gravelly, pebbly red-brown loam with gravel surface.

Vegetation description: *Acacia* aff. *aneura* (narrow, green; MET 15,850), *Acacia pruinocarpa*, *Acacia* aff. *ayersiana* (narrow form; MET 15,786) low open woodland over *Sarcostemma viminale* ssp. *australe*, *Eremophila caespitosa* scattered shrubs over scattered *Triodia pungens* hummock and *Aristida contorta* annual grassland.

Dominants: *Acacia* aff. *aneura* (narrow, green; MET 15,850) 3 + m 5-10%; *Acacia pruinocarpa* (1) 2-4 m < 1%; *Acacia* aff. *ayersiana* (narrow form; MET 15,786) 4 m 5-10%; *Sarcostemma viminale* ssp. *australe* 1-2 + m 1%; *Eremophila caespitosa* << 1-2%; *Triodia pungens* 40 cm 0-5%.

Notes: The *Aristida contorta* was abundant. The *Triodia pungens* and *Eremophila forrestii* ssp. *forrestii* were mostly only near the flowline (some also higher up). Very species poor. The *Ptilotus polystachyus* was dead.

Associated annuals: *Aristida contorta*, *Polygala* aff. *isingii*, *Paspalidium clementii*, *Enneapogon polyphyllus*, *Lobelia heterophylla*, *Trichodesma zeylanicum*.

Associated perennials: *Acacia rhodophloia*, *Eremophila forrestii* ssp. *forrestii*, *Acacia ayersiana*, *Cassia luerssenii*, *Solanum lasiophyllum*, *Eremophila latrobei* ssp. *glabra*, *Grevillea berryana*, *Canthium suaveolens*, *Tribulus suberosus*, *Cheilanthes sieberi* ssp. *sieberi*, *Cassia 'glaucifolia'*, *Acacia aneura* var. (green, flat; MET 15,946), *Cassia helmsii*, *Ptilotus schwartzii*, *Cassia oligophylla* x *helmsii*, *Acacia* aff. *catenulata*, *Ptilotus rotundifolius*, *Eremophila latrobei* ssp. *filiformis*, *Chrysocephalum semicalvum*, *Maireana villosa*.

Loc: 24 km west-south-west of The Governor, Hamersley Ranges, Fortescue Botanical District, Western Australia. AMG: 6-64-400E 74-40-375N (off map).

Coll.: Malcolm Trudgen Coll. no.: MET 18388 Date: 26-9-97
Voucher for the report: Flora and vegetation surveys of Orebody A and Orebody B in the West Angela Hill area, an area surrounding these orebodies, and of rail route options considered to link them to the existing Robe River Iron Associates rail line.
Site number: 1241 DONATED BY ROBE RIVER IRON ASSOCIATES

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Figure 2. Holotype of *Acacia catenulata* C.T.Whitesubsp. *occidentalis* Maslin (PERTH 06695582), scale = 5 cm.

Distribution and ecology. Confined to the Pilbara region, Western Australia, where it extends from the central Hamersley Range (around West Angelas) eastwards through the Ophthalmia and Hancock Ranges to Newman; it also occurs on Balfour Downs Station (about 150 km north-east of Newman) and on the old Great Northern Highway between Newman and Nullagine, just north of the Fortescue River on Roy Hill Station. A similar disjunction between the Hamersley Range and the Balfour Downs area occurs also in *A. bromilowiana* (see above) and *A. subcontorta* (see below). It forms dense populations in many places where it occurs (regeneration from seed), especially on the Wanna Munna Flats to the north of Giles Point in the Ophthalmia Range and in the Ethel Creek–Balfour Downs Station area. Occurs on red-brown hardpan flat or gently undulating terrain along diffuse watercourses or colluvial fans, sometimes extending to dry low rocky hills or ridges. It grows on (stony) shallow red-brown sandy loam, clay-loam, deep red loamy duplex soils or self-mulching cracking clays in open to moderately closed Low Woodlands of *Eucalyptus victrix* and/or with Mulga in the Boolgeeda, Wanna Munna and Coolibah Land Systems (Van Vreeswyk *et al.* 2004).

Flowering and fruiting period. Paucity of flowering and fruiting specimens makes it difficult to accurately determine the phenology of the subspecies. It appears to flower in response to rainfall between December and June, however, not all plants in given populations produce flowers during this period. Pods with mature seeds have been collected between August and October.

Conservation status. Not considered rare or endangered. However, it is noted that this species is not currently recorded from the Western Australian conservation estate, but significant populations do occur within the proposed Mulgalands Conservation Park between Karijini National Park and Newman.

Etymology. The subspecies name is derived from the Latin *occidentalis* (west, western) in allusion to the geographic location of this taxon relative to the typical subspecies.

Common name. Western Bendee (suggested new common name); the typical subspecies is called Bendee in Queensland. Some Pilbara collectors have referred to this taxon as Black Mulga but this common name is used for a number of Australian Wattles.

Affinities. Acacia catenulata belongs to *Acacia* sect. *Juliflorae* and is a very distinctive species on account of its flat, thin-textured, reticulately nerved pods which readily break into 1-seeded segments at the deep constrictions between the seeds. The typical subspecies which occurs in central Queensland with an outlier in north-east Northern Territory is distinguished most readily from subsp. *occidentalis* in having fluted trunks (Pedley 1973, 1978) and resinous, ± sparsely appressed-hairy new shoots which are dark coloured (brownish) when dry. Very few herbarium specimens of subsp. *catenulata* have been seen, nor has the taxon been inspected in the field.

While the pods of subsp. *occidentalis*, which readily break into 1-seeded articles at the constrictions between the seeds, readily distinguish this subspecies from all other Pilbara wattles, sterile or flowering plants may possibly sometimes be confused with either *A. distans* Maslin or *A. subcontorta* Maslin (see below). Apart from the pods, *A. distans* can be recognized by having much longer, interrupted flowering spikes (3–7(–11) cm long) and phyllodes which tend to have a denser indumentum of slightly longer hairs, and *A. subcontorta* by its ± contorted and horizontally spreading branches, generally longer spikes, partially united sepals and its generally straighter and narrower phyllodes with often red margins. *Acacia subcontorta* and *A. catenulata* subsp. *occidentalis* are sympatric on the Wanna Munna Flats near Giles Point in the Opthalmia Range and in the absence of pods care needs to be taken not to confuse the two. Along Jigalong Creek east of the Ethel Creek Station homestead *A. distans* and *A. catenulata* subsp. *occidentalis* are sympatric, although the latter tends to occupy micro-relief positions higher on the alluvial plain. A putative hybrid between *A. aneura* F.Muell. ex Benth. and *A. catenulata* subsp. *occidentalis* occurs between Newman and Jiggalong.

Notes. This species is generally killed under hot fire conditions. However, lightly scorched plants or those burnt under cool fire conditions resprout from the crown, along main stems and branches or from the truck just below ground level.

Acacia coriacea and A. sericophylla

Cowan and Maslin (1993) recognizes three subspecies within *A. coriacea* DC.: subsp. *coriacea*, subsp. *pendens* R.S.Cowan & Maslin and subsp. *sericophylla* (F.Muell.) R.S.Cowan & Maslin. These three taxa all occur in the Pilbara, the first two confined to the region and its immediate surrounds, the last extending eastwards through the arid zone to Northern Territory, South Australia, Queensland and New South Wales. Although it was known at the time that subsp. *sericophylla* differed from the other two subspecies in a number of important ways, Cowan and Maslin (1993) attributed subspecific rank to this taxon because it was considered that this approach best served the practical needs of users by enabling them to put names on collections of herbarium material. However, with the benefit of extensive field work in the Pilbara it has become untenable to maintain the Cowan and Maslin classification. The three taxa each have very distinctive field facies and a more biologically meaningful classification is to reinstate *A. coriacea* subsp. *sericophylla* as a distinct species, *A. sericophylla* F.Muell., and to regard *A. coriacea* as comprising two subspecies, subsp. *coriacea* and subsp. *pendens*. The most obvious and reliable character that distinguishes *A. coriacea* from *A. sericophylla* is the bark, however, growth form and habitat differences also uniquely identify each species and subspecies. There are phyllode, peduncle and pod characters that can be helpful in distinguishing the taxa, but these characters are not always reliable. Therefore, identification of Pilbara specimens based on herbarium material can sometimes be problematic, unless the collector has noted where the plant grew, its growth form and most importantly, its type of bark.

The following key to *A. sericophylla* and the two subspecies of *A. coriacea* will enable most plants referable to these taxa to be identified.

1. Bark thick and corky, yellow and spongy internally; peduncles (8–)10–20(–30) mm long; pods (prior to dehiscence) straight to shallowly or strongly curved (not irregularly or markedly coiled); phyllodes mostly 1–4(–7) mm wide; ± gnarled trees or sub-trees with non-pendulous branchlets. 'Spinifex' sandplains. (W.A., N.T., S.A., Qld, N.S.W.) .... **A. sericophylla**

1: Bark thin, fibrous and longitudinally fissured; peduncles 3–10(–12) mm long; pods(prior to dehiscence) markedly and often irregularly curved, twisted and/or openlycoiled, sometimes (in subsp. *coriacea*) openly curved and not twisted or coiled; (northwest W.A.).. 2

2. Dense, spreading shrubs or small trees 1–3(–4) m tall, occasionally prostrate; branchlets and phyllodes not pendulous; phyllodes 2–7(–8) mm wide, straight to shallowly or moderately recurved. Coastal dunes.. **A. coriacea** subsp. **coriacea**

2: Shapely trees mostly 3–10 m tall; branchlets and phyllodes normally gracefully pendulous or sub-pendulous; phyllodes 1–4 mm wide, shallowly to strongly recurved or sometimes shallowly serpentinous. Inland from the coast, normally along watercourses..**A. coriacea** subsp. **pendens**

Acacia sericophylla F.Muell., *J. Proc. Linn. Soc., Bot.* 3: 122 (1859).

Acacia coriacea subsp. *sericophylla* Cowan & Maslin, *Nuytsia* 9: 87 (1993); *Racosperma coriaceum* subsp. *sericophyllum* (F.Muell.) Pedley, *Austrobaileya* 6(3): 458 (2003). *Type*: Desert along the Suttor River, Qld, without date, *F.Mueller s.n.* (*holo*: ?MEL *n.v.*; *iso*: K).

Acacia coriacea var. *angustior* Maiden, *Forest Fl. New South Wales* 7: 154, pl. 242U (1920). *Syntypes*: Beta, Qld, June 1913, *J.L. Boorman* (NSW183183); Prairie, 30 miles [48 km] E of Hughenden, Qld, 1 September 1913, *R.H. Cambage* 3961 (NSW); Prairie, Qld, September 1918, *J.R. Chisholm* (NSW183181); New Angledool, N.S.W., February 1900, *A. Paddison* (NSW183180).

Acacia coriacea DC., *Prodr.* 2: 451 (1825); *Mem. Legum.* pt. 8, 446 (1827).

Racosperma coriaceum (DC.) Pedley, *J. Linn. Soc., Bot.* 92: 248 (1986). *Lecto*: Western Australia (sphalm. 'Nouvelle Holland. cote orient.'), [June – July 1801, N. Baudin Expedition] (G-DC, fruiting specimen, *fide* R.S. Cowan & B.R. Maslin, *Nuytsia* 9: 84 (1993); *isolecto*: K, P; *paralecto*: flowering specimen on type sheet (G-DC, P).

Acacia coriacea subsp. **coriacea**, *Nuytsia* 9: 85 (1993).

Acacia coriacea subsp. **pendens** R.S.Cowan & Maslin, *Nuytsia* 9: 86 (1993).

Racosperma coriaceum subsp. *pendens* (R.S.Cowan & Maslin) Pedley, *Austrobaileya* 6(3): 458 (2003). *Type*: Hamersley Ra. National Park, at Coppin Pool, 300 m upstream from crossing, Western Australia, 12 May 1980, *M. Trudgen* 2518 (*holo*: PERTH 00698423; *iso*: CANB, G, K, NY).

Acacia drepanocarpa

As currently defined *Acacia drepanocarpa* F.Muell. comprises two subspecies, subsp. *drepanocarpa* and subsp. *latifolia* Pedley, which are distinguished only by their phyllodes according to Pedley (1974: 10). However, preliminary observations of material at the Western Australian Herbarium (PERTH) suggests that the taxonomic status of this species in Western Australia needs to be reassessed.

In Western Australia, plants attributed to subsp. *drepanocarpa* occur at the western extremity of the Great Sandy Desert (adjacent to the 80 Mile Beach) where they extend from the Edgar Ranges (about 150 km due SE of Broome) south-west to near Cape Keraudren (about 100 km due NE of Port Hedland). There is a major geographic separation of over 1,000 km between these populations and the more easterly occurrences of subsp. *drepanocarpa* in Northern Territory and Queensland. The Western Australian plants are characterized by linear phyllodes measuring mostly 6–8 cm long, 1–2(–3) mm wide and with l:w = 20–80 and as such fall within the range of variation for the subspecies as reported by Pedley (1978: 150–151) and NSW (2001: 257–258). They differ, however, from the Northern Territory and Queensland plants of subsp. *drepanocarpa* in having more prominently raised phyllode nerves (at least when dry) and the gland being closer to the base, i.e. mostly 0–2 mm above the pulvinus (the gland on the Northern Territory and Queensland plants appears to be (2–)4–10 (–20) mm above the pulvinus but this needs to be checked against a wider range of material than has been examined by us). In these two respects the Western Australian plants accord better with subsp. *latifolia* than with subsp. *drepanocarpa*.

In Western Australia, plants referable to *A. drepanocarpa* subsp. *latifolia* extend from the Kimberley region south to the western extremity of the Great Sandy Desert from where they just reach the Pilbara region near the Gregory Range (about 300 km south-east of Port Hedland). This distribution is contiguous with the geographic range of subsp. *latifolia* in Northern Territory and Queensland. The Western Australian plants have phyllodes 4–8 cm long, (4–)5–12 mm wide, l:w = 5–15, the nerves are prominently raised and the gland is located 0–2 mm above the pulvinus.

Most of the plants in Western Australia attributed to *A. drepanocarpa* can be assigned to one or other subspecies based on their phyllodes (narrow in subsp. *drepanocarpa* and broad in subsp. *latifolia*). Furthermore, the distributions of the two subspecies appear not to overlap despite the fact that both occur in the Great Sandy Desert (subsp. *drepanocarpa* occurs further to the west than does subsp. *latifolia*).

However, in Western Australia there are some collections that, based on phyllode dimensions at least, appear to be intermediate between the two subspecies, their phyllodes measuring mostly 5–7 cm long, 3–5 mm wide, with l:w = 7–17. Geographically these plants are also intermediate between the two subspecies, being recorded from around Shay Gap in the Pilbara region (about 150 km north-west of Gregory Range), westwards to Cape Keraudren and northwards well into the geographic range of subsp. *drepanocarpa* (it is not known with certainty if the two entities are sympatric, but judging from herbarium label data they may well be). This seemingly intermediate entity has been given the phrase name *Acacia* sp. Nalgi (N.T. Burbidge 1317) at PERTH.

Further study is needed to determine the taxonomic status of these seemingly intermediate plants. The area in which they occur is rather remote and is poorly collected. It is possible that they represent a narrow phyllode form of subsp. *latifolia* or perhaps a hybrid between this subspecies and subsp. *drepanocarpa*. However, another and perhaps more likely possibility is that all the Western Australian plants currently ascribed to *A. drepanocarpa* may represent a single (variable) taxon which includes subsp. *latifolia*, 'subsp. *drepanocarpa*' (representing a particularly narrow phyllode form of the species) and the intermediate plants. If this is the case then this Western Australian entity (which extends into Northern Territory and Queensland as subsp. *latifolia*) probably warrants description as a species distinct from *A. drepanocarpa* (which then would not occur in Western Australia).

Acacia fecunda Maslin, *sp. nov.*

Frutices 1.5–3 m alti. *Ramuli* minute et dense albo-pilosi. *Phyllodia* anguste elliptica vel oblanceolata, recta et dimidiata vel leviter aut modice falcato recurvata, ad basim angustata, acuta, 8–12 cm longa, 10–15 mm lata, subtiliter multi-striata nervis 2 prominentibus; *pulvinus* 4–5 mm longus. *Inflorescentium* simplex; *pedunculi* 7–12 mm longi; *spicae* 20–40(–45) mm longae. *Flores* 5-meri; *calyx* gamosepalus, in lobis oblongo-triangularibus breviter divisus. *Legumen* abundantia, 7–9 cm longa, linearia, firme chartacea vel tenuissime crustacea. *Semina* in legumina longitudinalia, oblonga vel oblongo-elliptica, 3.5–4 mm longa, arillata.

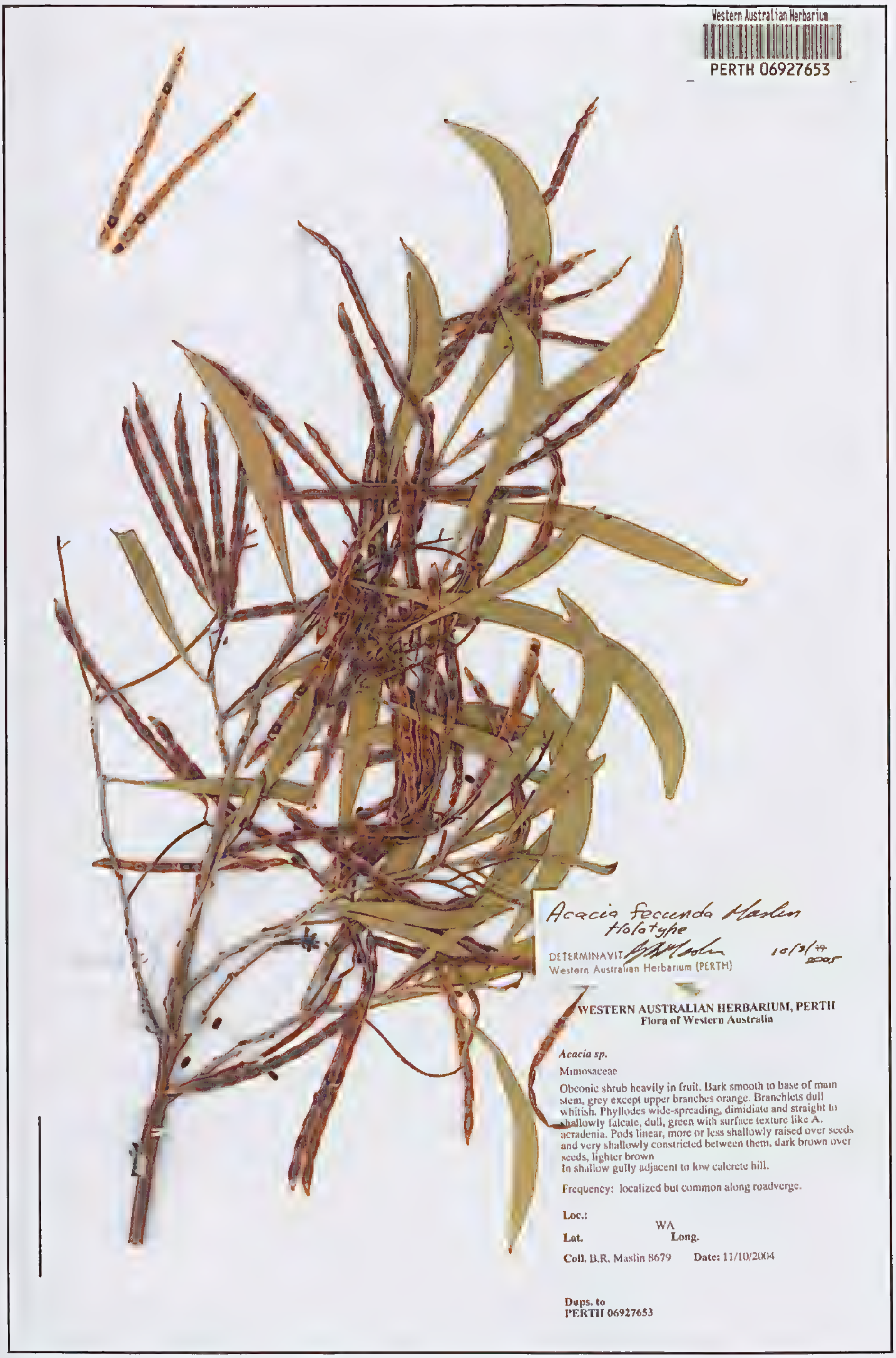
Typus: east of Nullagine, Western Australia [precise locality withheld for conservation reasons], 11 October 2004, *B.R. Maslin* 8679 (*holo*: PERTH 06927653; *iso*: K, MEL, NY, PERTH 06927645).

Acacia sp. Nullagine (B.R. Maslin 8510), in Council of Heads of Australasian Herbaria, *Australian Plant Census*, http://www.anbg.gov.au/chah/apc/index.html [accessed 19 February 2008].

Obconic *shrubs* 1.5–3 m tall, with 2–4 main stems (4–5 cm in diameter at base) arising from near ground level, crown open to sub-dense and spreading to about 3 m across. *Bark* thin, smooth (although with a few longitudinal fractures developed near base of stems on mature plants), grey on main stems, upper branches (and stems of young plants) orange. *Branchlets* slender, terete except angled at extremities, very finely ribbed, minutely and densely white-hairy (hairs straight or slightly crisped, mostly appressed except sometimes some sub-appressed or patent). *New shoots* light brown when first initiated due to a microscopic indumentum of irregularly-shaped scales intermixed with silvery non-resin hairs, ageing light green. *Stipules* caducous. *Phyllodes* narrowly elliptic to oblanceolate, straight and dimidiate to shallowly or moderately falcately recurved, narrowed at base, obtuse or acute with a sometimes up-turned apical callosity, 8–12 cm long, 10–15 mm wide, wide-spreading to ascending, coriaceous to thinly coriaceous, glabrous or sparsely and minutely appressed-hairy, often slightly resinous (but not sticky), dull or with a very slight sheen, green or bluish green (and sometimes lightly pruinose when young); finely multistriate with 2 sub-central *nerves* more evident than the rest, minor nerves closely parallel but sometimes very few longitudinally anastomosing, the 2 main nerves confluent with one another near pulvinus or ± free but not confluent with lower margin although situated close to it; *marginal nerve* narrow, discrete, yellowish to light brown; *pulvinus* 4–5 mm long, distinct, orange when fresh (drying dull yellow to brownish), minutely hairy at least on upper surface, normally finely transversely wrinkled and sometimes shallowly longitudinally grooved or ridged (at least when dry). *Inflorescences* simple, 2 per axil, new shoots arising from within angle formed by peduncles; *peduncles* 7–12 mm long, sub-stout, glabrous, scurfy or minutely hairy as on branchlets; *receptacle* glabrous; *basal peduncular bract* triangular, *c.* 1 mm long, caducous; *spikes* 20–40(–45) mm long, 5–6 mm wide, light golden, densely flowered. *Bracteoles* linear-spathulate, *c.*1 mm long. *Flowers* 5-merous; *calyx* gamosepalous, 1/2 to 3/5 length of corolla, very shortly divided into oblong-triangular lobes, calyx tube minutely white-hairy and not obviously nerved; *petals* 1.5 mm long, sub-glabrous to appressed-hairy, very obscurely 1-nerved to nerveless; *ovary* densely minutely villous. *Pods* prolific, linear, very slightly constricted between seeds and ± shallowly but distinctly rounded over them, 7–9 cm long, 3–4 mm wide, firmly chartaceous to very thinly crustaceous, straight or almost so, sub-glabrous to minutely appressed-hairy (observe indumentum under magnification), brown (darkest over seeds), the marginal nerve narrow and scarcely thickened. *Seeds* longitudinal in pods, obloid to obloid-ellipsoid, 3.5–4 mm long, *c.* 2 mm wide, compressed (1 mm thick), dark brown with a satin lustre; *pleurogram* indistinct, open towards the hilum; *areole* elongate (*c.* 2 mm long, 0.5 mm wide); *funicle* filiform, abruptly expanded into a small terminal, white *aril*. (Figure 3)

Characteristic features. Obconic *shrubs* with spreading, ± open crowns. *Branchlets* slender, minutely and densely white-hairy. *Phyllodes* narrowly elliptic to oblanceolate, straight and dimidiate to falcately recurved, narrowed at base, 8–12 cm long, 10–15 mm wide, wide-spreading to ascending, green or bluish green, finely multistriate with 2 sub-central nerves more evident than the rest, the minor nerves closely parallel; *pulvinus* 4–5 mm long, distinct, orange when fresh. *Spikes* 2 per axil, light golden, densely flowered, 20–40(–45) mm long; *peduncles* 7–12 mm long, sub-stout. *Pods* produced in great profusion, 7–9 cm long, 3–4 mm wide, linear, very slightly constricted between seeds and ± shallowly but distinctly rounded over them, thin-textured, sub-glabrous to minutely appressed-hairy. *Seeds* longitudinal in pods, dark brown with a satin lustre; *aril* white.

Selected specimens examined. WESTERN AUSTRALIA [precise localities withheld for conservation reasons]: East of Nullagine: 14 Apr. 1967, *J.S. Beard* 4605 (PERTH); 30 May 2004, *B.R. Maslin* 8510 (AD, CANB, DNA, K, MEL, NSW, NY, PERTH); 30 May 2004, *B.R. Maslin* 8512 (G, PERTH); 16 Aug. 2006, *B.R. Maslin* 8884 (PERTH); 27 Aug. 2004, *S. van Leeuwen* 5224 (NSW, PERTH).



Western Australian Herbarium
PERTH 06927653

Acacia fecunda Maslin
Holotype
DETERMINAVIT B.R. Maslin 10/3/ 2005
Western Australian Herbarium (PERTH)

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Acacia sp.

Mimosaceae

Obconic shrub heavily in fruit. Bark smooth to base of main stem, grey except upper branches orange. Branchlets dull whitish. Phyllodes wide-spreading, dimidiate and straight to shallowly falcate, dull, green with surface texture like A. acradenia. Pods linear, more or less shallowly raised over seeds and very shallowly constricted between them, dark brown over seeds, lighter brown
In shallow gully adjacent to low calcrete hill.

Frequency: localized but common along roadverge.

Loc.:
WA
Lat. **Long.**
Coll. B.R. Maslin 8679 **Date:** 11/10/2004

Dups. to
PERTH 06927653

Figure 3. Holotype of *Acacia fecunda* Maslin (PERTH 06927653), scale = 5 cm.

Distribution and ecology. Confined to the Pilbara region where it is known only from a few disjunct populations east of Nullagine (to near the Oakover River) where it grows in areas underlain by Mosquito Creek sedimentary rocks. It is likely that further survey of similar habitats will reveal additional populations (but these areas are remote and difficult of access) although it is not expected that this species will be shown to have a particularly extensive geographic range. *Acacia fecunda* is often common in the places where it occurs and it favours water-gaining sites.

Flowering and fruiting period. Flowering specimens have been collected between mid-April and late May and it is probable that some flowers would remain on the plants until about mid-June. Only a single fruiting collection has been made (the Type) and this was collected around mid-October. It is estimated that mature seed would occur from around late September to about early November.

Conservation status. DEC Conservation Codes for Western Australian Flora: Priority Three (Atkins 2008). It is noted, however, that this species is currently not known from the Western Australian conservation estate.

Etymology. The species name is derived from the Latin *fecundus* (fruitful, fertile, prolific) in allusion to the large number of pods produced.

Affinities. *Acacia fecunda* belongs to sect. *Juliflorae* and appears most closely related to *A. gonoclada* F.Muell. These two species have similar phyllodes (especially size and nervature), simple inflorescences, pedunculate spikes, 5-merous flowers, very shortly lobed calyces and linear, thin-textured pods and longitudinally-oriented seeds with white arils. *Acacia gonoclada* is most readily distinguished from *A. fecunda* by its stouter, acutely angled branchlets, shorter peduncles (mostly 3–6 mm long), shorter pods (20–45 mm long) and generally shorter spikes (10–25 mm long), and often shallowly incurved (never recurved) phyllodes. *Acacia gonoclada* does not grow in the Pilbara region but occurs further north in the Kimberley region from where it extends eastwards through Northern Territory to Queensland. The new species may superficially resemble two Pilbara species, *A. elachantha* M.W.McDonald & Maslin and *A. hamersleyensis* Maslin. *Acacia elachantha* is readily recognised by its phyllodes having 3 prominent longitudinal nerves with widely spaced, longitudinally anastomosing minor nerves, seeds with yellow arils and densely hairy new shoots (hairs silver or yellow). *Acacia hamersleyensis* is most readily recognized by its glaucous to sub-glaucous phyllodes, often larger spikes (36–60 × 6–8 mm) and most particularly by its broader (5–8 mm wide), hairy pods with obliquely placed seeds. *Acacia fecunda* may be superficially similar to *A. tumida* Benth. var. *pilbarensis* M.W.McDonald in having spicate inflorescences and quite large phyllodes (the two taxa grow in the same general area) but in var. *pilbarensis* the branchlets are glabrous and usually pruinose, the spikes are arranged in racemes and the pods are broader (6–7 mm wide) and woody.

Notes. *Acacia fecunda* regenerates from seed following fire or other disturbance (may form dense roadside populations). Plants flower from an early age (when only about 0.5 m tall and probably no older than about one year).

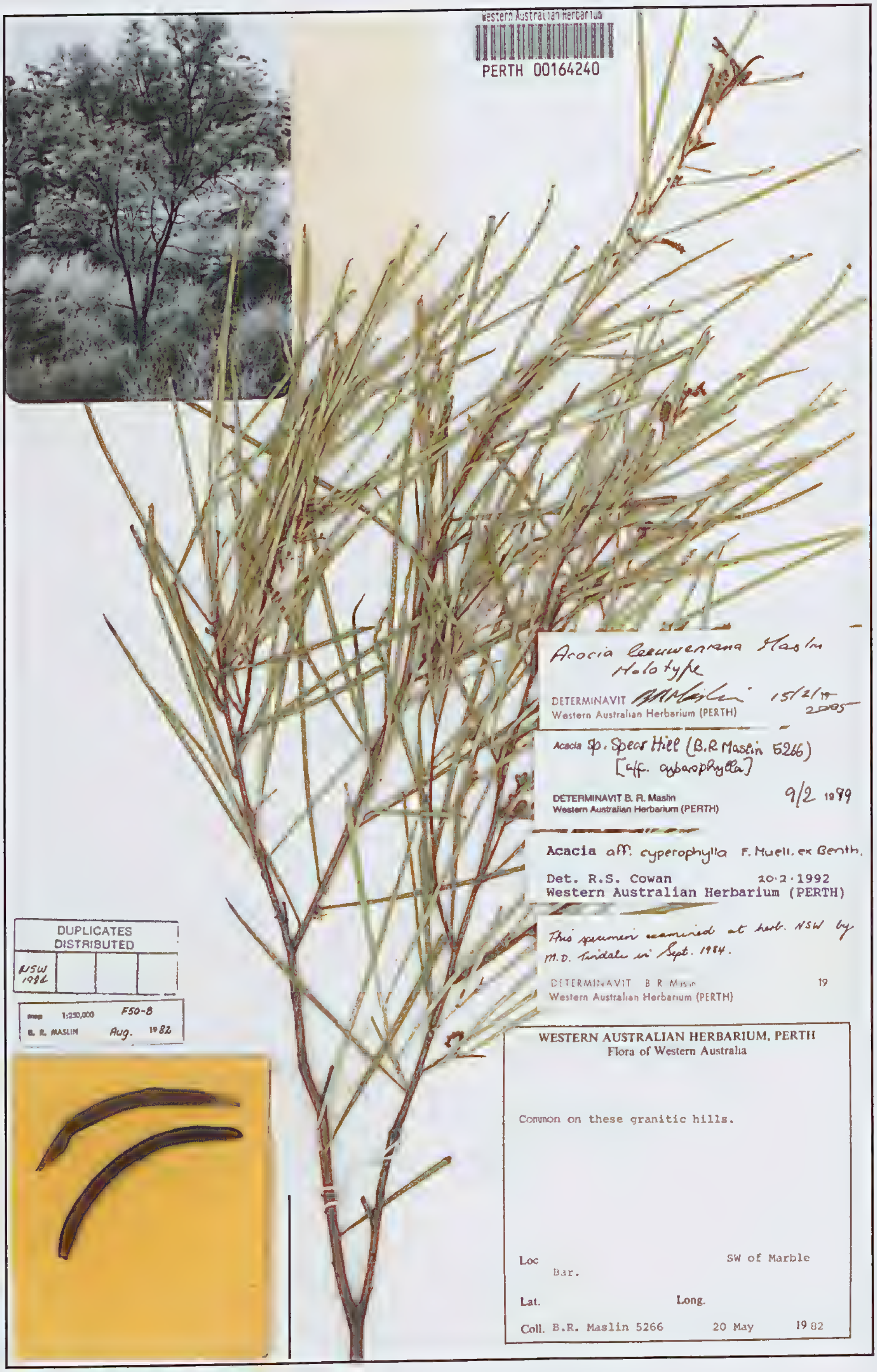
Acacia leeuweniana Maslin, *sp. nov.*

Abores obconicae bene formatae 4–8(–14) m altae, nec ramuli neque phyllodia pendulosa. *Cortex* 'Minni Ritchi' (i.e. brunneolo-ruber et in angusto retrorse laciniis crispatis in quoquo extremo exfoliatus), plantis veteres basim caulium vagina grisea brevi ornati. *Ramuli* fragili. *Phyllodia* plerumque linearia, 7–12(–15) cm longa, 1–2(–2.5) mm wide, non praesertim rigida, recta vel fere recta, plana (sed plantae juvenales et saepe adulescentes teretes), viridia vel obscure griseo-viridia vel sub-glauca, subtiliter longitudinaliter multi-striata, apicibus pungentibus vel sub-pungentibus. *Spicae* pallido aureae, floribus non praecipue dense ordinatis. *Calyx* longitudinale *c.* 1/2 corollae partes aequans, in lobis late triangularibus breviter dissectus. *Legumina* late-linearia, 3–10 cm longa, 6–8 mm lata, plana, plerumque leviter curvata, coriaceo-crustacea vel ± sub- lignosa. *Semina* grandia (7–11 mm longa, 3.5–5 mm lata), plana, arillo parvo. Ad collibum graniticum limitatis.

Typus: south-west of Marble Bar, Western Australia [precise locality withheld for conservation reasons], 20 May 1982, *B.R. Maslin* 5266 (*holo*: PERTH 00164240; *iso*: K, MEL, NSW, NY, PERTH).

Shapely, obconic, erect *trees* 4–8(–14) m tall, with a single trunk or very few trunks from ground level, neither branchlets nor phyllodes pendulous. *Juvenile plants* (to *c.* 1 m tall) divaricately branched and possessing short (sometimes only 30–40 mm long), rigid, terete, pungent phyllodes, some of which may occur in clusters on brachyblastic short-shoots (as occurs in some forms of Mulga). *Adolescent plants* often with a conifer-like appearance, the lower branches ± horizontally spreading with those higher up ascending, the normally terete phyllodes typically mealy white due to surface wax. *Bark* 'Minni Ritchi' (i.e. brownish red and exfoliating in narrow shavings that curl retrorsely from each end), ageing grey (a short grey stocking occurs around base of stems of oldest plants). *New shoots* glabrous, glaucous due to white surface wax. *Branchlets* brittle (snapping easily with a clean break), sometimes with 'Minni Ritchi' bark evident, terete, ribs very obscure, glabrous, light brown or dark red-brown towards extremities. *Phyllodes* (mature plants) normally linear, 7–12(–15) cm long, 1–2(–2.5) mm wide, not especially rigid, straight or almost so, flat, glabrous or sometimes very sparsely and minutely appressed-hairy, green to dull grey-green or sub-glaucous; very finely multistriate with *nerves* parallel and close together; *apices* narrowed to a pungent or sub-pungent point; *pulvinus* finely transversely wrinkled and yellow or brown (when dry). *Gland* not prominent, situated on upper margin of phyllode 0–1 mm above the pulvinus. *Inflorescences* simple, 2–6 per axil; *peduncles* 5–10 mm long, glabrous or (especially at base) sometimes minutely and silvery sericeous, resinous (but not sticky); *spikes* 10–20 mm long (when dry), light golden, the flowers not especially densely arranged along the glabrous receptacle. *Bracteoles* very small and insignificant, *c.* 0.5 mm long. *Flowers* 5-merous, buds quite large; *calyx* about 1/2 (or slightly more) length of corolla, gamosepalous, divided for about 1/4 or less its length into broadly triangular, sparsely ciliolate lobes; *calyx tube* nerveless, glabrous or almost so, ± broad-based (*c.* 1 mm wide); *petals* 1.5–2 mm long, glabrous, very obscurely 1–nerved. *Pods* broad-linear, 3–10 cm long, 6–8 mm wide, flat, without internal partitions, coriaceous-crustaceous to ± sub-woody, shallowly (occasionally a few strongly) curved, glabrous, resinous (but not sticky), very obscurely and sparingly longitudinally nerved, greyish light brown (exterior), dark red-brown (interior), the marginal nerve often visible but not prominent. *Seeds* longitudinal in pods, obloid or sometimes obloid-ellipsoid, large (7–11 mm long, 3.5–5 mm wide), flattened (1.5–2 mm thick), slightly shiny, brown (commonly tinged greyish); *pleurogram* 'u'-shaped to 'v'-shaped with a wide opening towards the hilum, often bordered by a diffuse band of dull yellow tissue; *areole* small, *c.* 1 mm long, 0.8–1 mm wide; *funicle* expanded into a very small terminal *aril*. (Figure 4)

Characteristic features. Shapely, obconic *trees* with neither branchlets nor phyllodes pendulous, adolescent plants often with a conifer-like appearance. *Bark* 'Minni Ritchi' (i.e. brownish red and exfoliating in narrow shavings that curl retrorsely from each end), a short grey stocking occurs around base of stems of oldest plants. *Branchlets* brittle (snapping easily with a clean break). *Phyllodes* (mature plants) linear and long (7–12(–15) cm long), flat (terete on juvenile plants), straight or almost so, green to dull grey-green or sub-glaucous, not especially rigid, very finely multistriate, pungent or sub-pungent. *Spikes* light golden, the flowers not especially densely arranged. *Calyx* about 1/2 (or slightly more) length of corolla, shortly dissected into broadly triangular lobes. *Pods* broad-linear,



Western Australian Herbarium
PERTH 00164240

Acacia leeuweniana Maslin
Holotype
DETERMINAVIT B.R. Maslin 15/2/~~19~~ 2005
Western Australian Herbarium (PERTH)

Acacia sp. Spear Hill (B.R Maslin 5266)
[aff. cyperophylla]
DETERMINAVIT B. R. Maslin 9/2 1999
Western Australian Herbarium (PERTH)

Acacia aff. cyperophylla F. Muell. ex Benth.
Det. R.S. Cowan 20·2·1992
Western Australian Herbarium (PERTH)

This specimen examined at herb. NSW by M.D. Tindale in Sept. 1984.
DETERMINAVIT B R Maslin 19
Western Australian Herbarium (PERTH)

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Common on these granitic hills.

Loc SW of Marble Bar.
Lat. Long.
Coll. B.R. Maslin 5266 20 May 1982

DUPLICATES DISTRIBUTED
NSW 1986

map 1:250,000 F50-8
B. R. MASLIN Aug. 1982

Figure 4. Holotype of *Acacia leeuweniana* Maslin (PERTH 00164240), scale = 5 cm.

6–8 mm wide, mostly shallowly curved, coriaceous-crustaceous to ± sub-woody, flat. *Seeds* large (7–11 mm long, 3.5–5 mm wide), flattened; *aril* small. Confined to granite outcrops.

Selected specimens examined. WESTERN AUSTRALIA [precise localities withheld for conservation reasons]: SW of Marble Bar: 19 Apr. 1967, *J.S. Beard* 4627 (PERTH); 27 June 1981, *B.R. Maslin* 4951A–F (all PERTH); 18 July 2000, *B.R. Maslin* 8103 (PERTH); 29 May 2004, *B.R. Maslin* 8490 (AD, CANB, DNA, PERTH); 18 Oct. 1983, *P. Ryan s.n.* (PERTH 00165212, 00165204 & 00165239); 26 Oct. 1988, *L. Thomson* LXT 1160 (PERTH). S of Port Hedland: 29 May 2004, *B.R. Maslin* 8492 (CANB, MEL, NSW, PERTH); 9 Sep. 2004, *S. van Leeuwen* 5247 (K, MEL, NSW, PERTH).

Distribution and habitat. Known from only two granite rocks in the Pilbara region, Western Australia. It is common in the places where it occurs.

Flowering and fruiting period. Flowers have been recorded in April/May (during which time some plants may also be sterile) and also late October. It is quite possible that this species flowers in response to the timing and intensity of rainfall events. Pods with mature seeds have been collected from mid- to late October.

Conservation status. DEC Conservation Codes for Western Australian Flora: Priority One (Atkins 2008).

Etymology. This handsome new species is named in honour of Dr Stephen van Leeuwen, Research Scientist with the Department of Environment and Conservation (and second author of the present paper), in recognition of the major contribution that he has made to our understanding of the Pilbara flora. Stephen has worked in the Pilbara for 25 years and apart from his extensive documentation and collections of plants of the region during this period he has facilitated the work of many other people through his guidance (technical, scientific and in the field) and advice. Stephen is in charge of the botanical component of the comprehensive 'Pilbara Biological Survey' that is currently in progress.

Common name. Leeuwen's Wattle (suggested new common name).

Affinities. Acacia leeuweniana belongs to *Acacia* sect. *Juliflorae* and is most closely related to *A. cyperophylla* F.Muell. which comprises two varieties, only one of which occurs in the Pilbara region. The typical variety is widespread, ranging from the Ashburton district south of the Pilbara eastwards through Western Australia to South Australia, Northern Territory and Queensland; var. *omearana* Maslin is known from only two Pilbara populations, one near Nullagine and the other north-west of Marble Bar. *Acacia cyperophylla* is most readily distinguished from *A. leeuweniana* by its normally terete mature phyllodes and by the fact that it grows along watercourses (not granite hills as does the new species); var. *omearana* is further recognised by its distinctively pendulous branchlets and phyllodes. *Acacia cyperophylla* var. *cyperophylla* commonly has slightly narrower pods than those of *A. leeuweniana* (mostly 4–6 mm wide in W.A. plants, although reaching 9 mm in eastern Australia), its flowers tend to be more widely spaced within the spike (best observed in mature buds just prior to anthesis) and the plants appear to develop a longer stocking of grey bark at the base of stems below the characteristic reddish Minni Ritchi bark.

Notes. This species was first collected in 1967 by J.S. Beard from south-west of Marble Bar and was originally considered to be a variant of *A. rhodophloia* Maslin (*fide* Maslin 1980: 318). However, in the light of further study and collections it is now clear that its affinities lie more closely with *A. cyperophylla* (*fide* NSW 2001a: 291).

Acacia minutissima Maslin, *sp. nov.*

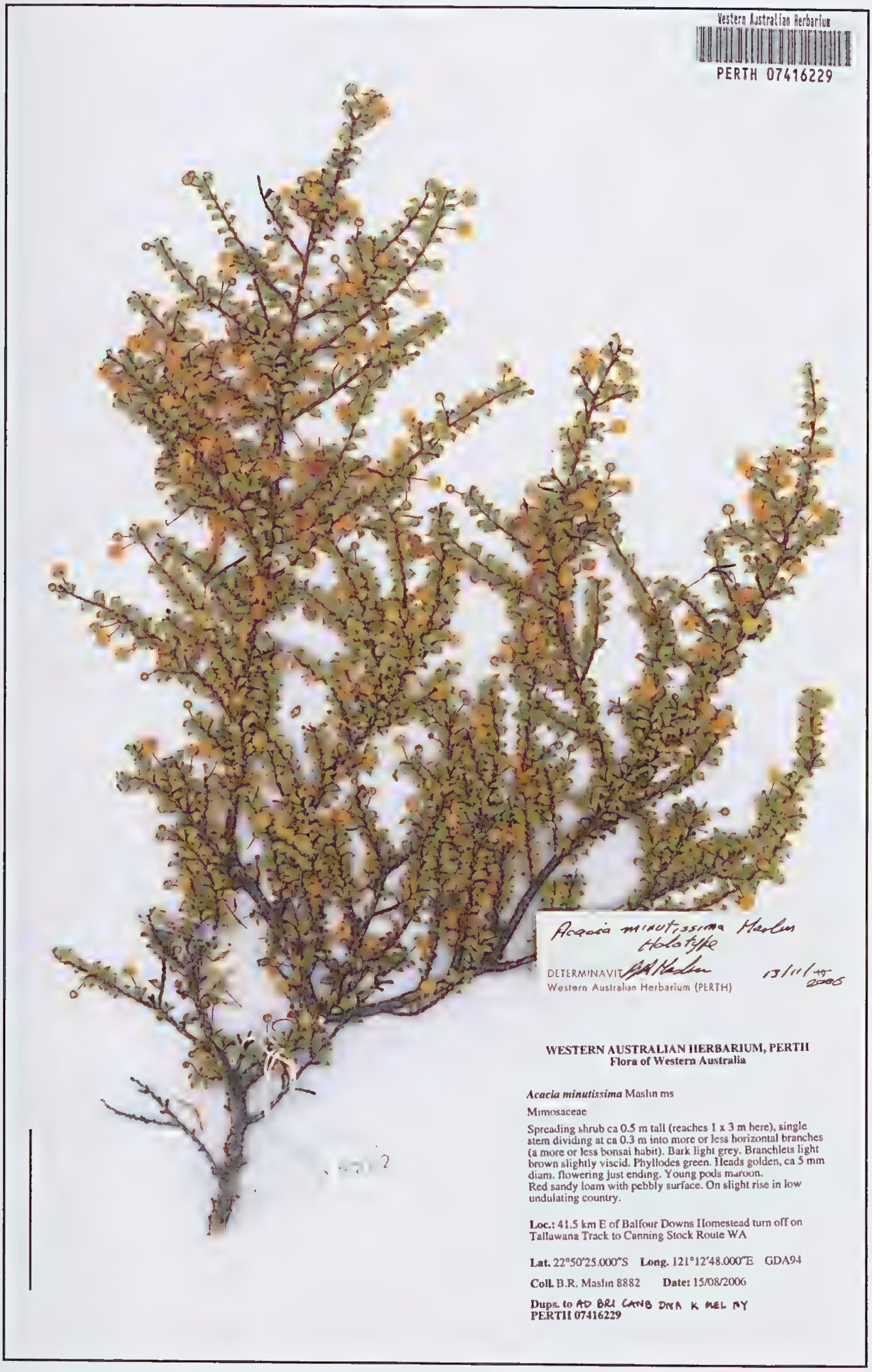
Fructices intricate ramosi 0.3–1(–1.5) m alti. *Ramuli* glabri, lenticellati, resinosi. *Stipulae* persistentae, erectae, 0.5–1 mm longae. *Phyllodia* asymmetricaliter elliptica vel obtriangularia, margine supero profunde convexo vel ad glandem angulato, 3–6(–7) mm longa, 2–3 mm lata, glabra, costa centrali vel leviter excentrica, plerumque gradatim angustata in apicem brevi-acuminati et sursum in acumen distinctum rigidm subulatum terminans. *Inflorescentia* simplices; *pedunculi* glabri, 6–8 mm longi; *capitula* globularia. *Flores* 5-meri; *sepala* libra, lineari-spathulata. *Legumen* 10–40 mm longa 3–4 mm lata, linearia vel anguste oblonga, firme chartacea, glabra. *Semina* non vidi.

Typus: 41.5 km east of Balfour Downs homestead turn-off on Tallawana Track to Canning Stock Route, Western Australia, 15 August 2006, *B.R. Maslin* 8882 (*holo*: PERTH 07416229; *iso*: AD, BRI, CANB, DNA, K, MEL, NY).

Acacia maitlandii variant, Maslin (1981: 129, 2001: 388).

Acacia sp. Talawana (B.R. Maslin 8540), in Council of Heads of Australasian Herbaria, *Australian Plant Census*, http://www.anbg.gov.au/chah/apc/index.html [accessed 19 February 2008].

Diffuse, intricately and openly branched, low-spreading (sometimes semi-prostrate) *shrubs* 0.3–(–1.5) m tall and at least 1–3 m across, stem dividing just above ground level into ± horizontally spreading branches which sometimes produces a pseudo-bonsai growth form, oldest plants having a somewhat craggy appearance due to persistent, short lateral branches which are denuded of phyllodes. *Bark* light grey, slightly roughened. *Branchlets* terete, finely ribbed (rib most evident for a short distance below insertion of phyllodes), lenticellate (lenticels scattered, circular, dull yellow), glabrous, resinous, slightly viscid when fresh but not sticky when dry, light brown or reddish brown at extremities but soon ageing grey. *Stipules* persistent, erect and appressed to branchlets, enveloped and often obscured by resin on young branchlets, triangular, 0.5–1 mm long, 0.4–0.5 mm wide at base, slightly thickened. *Phyllodes* asymmetrically elliptic to obtriangular, broadest at or above the middle, lower margin ± shallowly convex or sometimes almost straight, the upper margin longer than lower and markedly convex or angled at the gland, 3–6(–7) mm long, 2–3 mm wide, l:w = 1–1.6, glabrous, smooth, green; *midrib* ± evident (at least when dry), central or slightly excentric, sometimes with a less pronounced second nerve on upper side of midrib extending from the pulvinus towards the gland; *apices* abruptly or more commonly gradually narrowed to a short-acuminate apex and terminating in a distinct, rigid, subulate, pungent, straight, brown point 0.5–1 mm long. *Gland* situated on upper margin of phyllode 2–4 mm above the base (at, or above, the centre of the phyllode). *Inflorescences* simple, 1 per axil; *peduncles* glabrous, 6–8 mm long, red (at least when fresh), base ebracteate; *heads* globular, densely 40–50-flowered, 5 mm in diameter when fresh, golden; *flower buds* dull red. *Bracteoles* spathulate and sparsely hairy, *c.* 1 mm, claws linear, the laminae inflexed, widely ovate, *c.* 0.3 mm wide and slightly thickened. *Flowers* 5-merous; *sepals* 2/3 to 3/4 length of corolla, free, linear-spathulate, sparsely hairy (morphology same as bracteoles); *petals c.* 1.5 mm long, glabrous, nerveless. *Pods* (old fruiting valves), linear to narrowly oblong, flat but shallowly rounded over seeds, not or very shallowly constricted between seeds, 10–40 mm long, 3–4 mm wide, firmly chartaceous, sub-straight to slightly curved, glabrous, dark brown (pods maroon-coloured when first initiated), marginal nerve yellow to light brown. *Seeds* not seen but *funicles* very short (*c.* 1 mm long), filiform and persisting on inside of pods. (Figure 5)



Western Australian Herbarium
PERTH 07416229

Acacia minutissima Maslin
Holotype

DETERMINAVIT
Western Australian Herbarium (PERTH)
13/11/~~19~~ 2006

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Acacia minutissima Maslin ms

Mimosaceae

Spreading shrub ca 0.5 m tall (reaches 1 x 3 m here), single stem dividing at ca 0.3 m into more or less horizontal branches (a more or less bonsai habit). Bark light grey. Branchlets light brown slightly viscid. Phyllodes green. Heads golden, ca 5 mm diam. flowering just ending. Young pods maroon.
Red sandy loam with pebbly surface. On slight rise in low undulating country.

Loc.: 41.5 km E of Balfour Downs Homestead turn off on Tallawana Track to Canning Stock Route WA

Lat. 22°50'25.000"S **Long.** 121°12'48.000"E GDA94

Coll. B.R. Maslin 8882 **Date:** 15/08/2006

Dups. to AD BRI CANB DNA K MEL NY
PERTH 07416229

Figure 5. Holotype of *Acacia minutissima* Maslin (PERTH 07416229), scale = 5 cm.

Characteristic features. Intricately and openly branched, low-spreading glabrous *shrubs*. *Bark* light grey, slightly roughened. *Branchlets* lenticellate, resinous (slightly viscid when fresh but not sticky when dry), light brown or reddish brown at extremities. *Stipules* persistent, very small, erect, enveloped and often obscured by resin on young branchlets. *Phyllodes* asymmetrically elliptic to obtriangular, broadest at or above the middle, lower margin ± shallowly convex or sometimes almost straight, the upper margin longer than lower and markedly convex or angled at the gland, small, 3–6(–7) mm long, 2–3 mm wide, l:w = 1–1.6, midrib central or slightly excentric; *apices* normally short-acuminate and ending in a distinct, rigid, pungent, brown point. *Inflorescences* simple, 1 per axil; *peduncles* short (6–8 mm long), red when fresh, base ebracteate; *heads* globular, 40–50-flowered. *Pods* (old fruiting valves) 10–40 mm long, 3–4 mm wide, linear to narrowly oblong, not or very shallowly constricted between seeds, flat but shallowly rounded over seeds, firmly chartaceous. *Funicle* not expanded into an aril.

Other specimens examined. WESTERN AUSTRALIA: between Windy Corner and Well 24, Little Sandy Desert, 39 miles (62.4 km) from Windy Corner, Canning Stock Route, 1 Aug. 1967, *J.S. Beard* 4923 (PERTH); 32 km ESE of Canning Stock Route Well 24, Little Sandy Desert, 19 July 2001, *P.K. Latz* 17851 (NT *n.v.*, PERTH); Balfour Downs Station, *c.* 40 km E along Talawana Track, 1 June 2004, *B.R. Maslin* 8540 (K, PERTH); Balfour Downs Station, 49 km E along Talawana Track, 1 June 2004, *B.R. Maslin* 8542 (PERTH); 41.5 km E of Balfour Downs homestead turn-off on Tallawana Track to Canning Stock Route, Western Australia, 15 Aug. 2006, *B.R. Maslin* 8882A (PERTH); Little Sandy Desert, 2 May 1979, *A.S. Mitchell* 1017 (NT *n.v.*, PERTH); Keartland District, 65 km E of Calvert Range, 25 June 1984, *G.J. Morse* 208 (PERTH); about 40 km SE of Jigalong Community on track to Boonawarra, 26 June 1996, *A.L. Payne* PRP 1368 (PERTH); about 120 km E of Balfour Downs Homestead on Talawana Track to Rudall River, 1 Apr. 1995, *H. Pringle* PRP 96B (PERTH).

Distribution and ecology. Occurs in the eastern extremity of the Pilbara (east of Balfour Downs Station) extending east into the Little Sandy Desert to the general vicinity of Lake Disappointment in a series of discontinuous populations. This new species was noted under *A. maitlandii* F.Muell. in Maslin (1981: 129 and 2001: 388) where it was erroneously referred to as being recorded from the Gibson Desert. In the Pilbara *A. minutissima* is found in a few localized populations and is not uncommon in the places where it occurs. It most commonly grows on sand or loam (sometimes with a gravelly mantle) on plains or in swales between sand dunes, in shrub steppe with *Triodia* ('Spinifex') hummock grassland understorey (the Spinifex often overtops plants of *A. minutissima*). The Little Sandy Desert collection by Mitchell was gathered from a chenopod flat which, judging from the extant collections, seems to be an atypical habitat for this species.

Flowering and fruiting period. Because of the paucity of specimens it is difficult to determine the phenology of this species. Flowering commences in mid July or early August and probably extends to about September. Although mature pods and seeds have not been seen they would be expected to occur in November and perhaps early December.

Conservation status. Not considered rare or endangered. However, it is noted that the species is currently not known from the Western Australian conservation estate.

Etymology. The botanical name is derived from the Latin *minutus* (little, small) and the adjectival superlative *–issimus* (very), in reference to the extremely small phyllodes which characterize this species.

Affinities. *Acacia minutissima* is a member of *Acacia* sect. *Acacia* and together with *A. subtiliformis* Maslin (see below) is related to *A. maitlandii* which is most readily distinguished from both by its much longer phyllodes (i.e. 7–25 mm). *Acacia subtiliformis* and *A. minutissima* are superficially very similar, especially in that they are both glabrous shrubs with globular, densely-flowered heads and very small, asymmetric, pungent-pointed phyllodes; they also share other significant characters such as lenticellate branchlets, small stipules which are embedded in a resin (at least on the young branchlets), simple inflorescences with ebracteate peduncles and free sepals. *Acacia subtiliformis* is most readily distinguished from *A. minutissima* in its growth form (tall, spindly, wispy, single-stemmed shrubs), branching pattern (the ultimate branchlets are longer, less rigid and not as divaricately divided) and its phyllodes which are slightly smaller (mostly 2–3.5 mm long and less than 2 mm wide) and differently shaped (most obvious is that the phyllodes of *A. subtiliformis* are never obtriangular, their upper margin is less prominently convex and is never angled at the gland, and the apex is less acuminate with a slightly shorter terminal cusp). Mature pods and seeds of *A. minutissima* have not been seen but judging from old fruiting valves it is unlikely that they will be very different from those of *A. subtiliformis*. The two species are not known to grow together.

Notes. *Acacia minutissima* was first collected by J.S. Beard in 1967 from the Canning Stock Route in the Little Sandy Desert. This species is probably killed by fire and regenerates from seed.

Acacia robeorum Maslin, *sp. nov.*

Frutices glabri 2–3 m alti, ramis superioribus pallido aeneis. *Ramuli* luteoli vel pallido croceo-brunnei, nec pruinosi. *Stipula* spinosa, in plantis juvenalis praesentia sed aetate absentia. *Phyllodia* linearia vel anguste oblonga vel linearia-oblanceolata, 15–25(–35) mm longa (1–)2–3(–4) mm lata, l:w = (5–)6–10(–14), laete viridia, aliquantum carnosa, longitudinaliter rugata, costa et venis lateralibus plerumque non manifestis in statu sicco. *Inflorescentiae* simplices, in surculos novos initiatae pedunculo solitario intra axillum phyllodiorum formanti, phyllodiis subtentibus maturentibus ante anthesin; *capitula* aurea, 40–60-florifera. *Legumina* oblonga vel anguste oblonga, (15–)25–40(–60) mm longa, 6–8(–9) mm lata, papyracea, plana sed supra semina secus in linea media rotundata, inter-semines vix constricta. *Semina* in legumino transverse posita, nigra, ± non variegata; *arillus* parvus.

Typus: Balfour Downs Station (north-east of Newman) just east of Christies Crossing, Western Australia, 13 August 2006, *B.R. Maslin* 8858 (*holo*: PERTH 07415893; *iso*: CANB, K, MEL).

Acacia sp. aff. *victoriae*, Maslin in J. Jessup, *Fl. Central Australia* p. 131 (1981).

Acacia synchronicia variant, Maslin (1992: 304, 2001: 379).

Acacia sp. Rudall River (B.R. Maslin 2046A), in Council of Heads of Australasian Herbaria, *Australian Plant Census*, http://www.anbg.gov.au/chah/apc/index.html [accessed 19 February 2008].

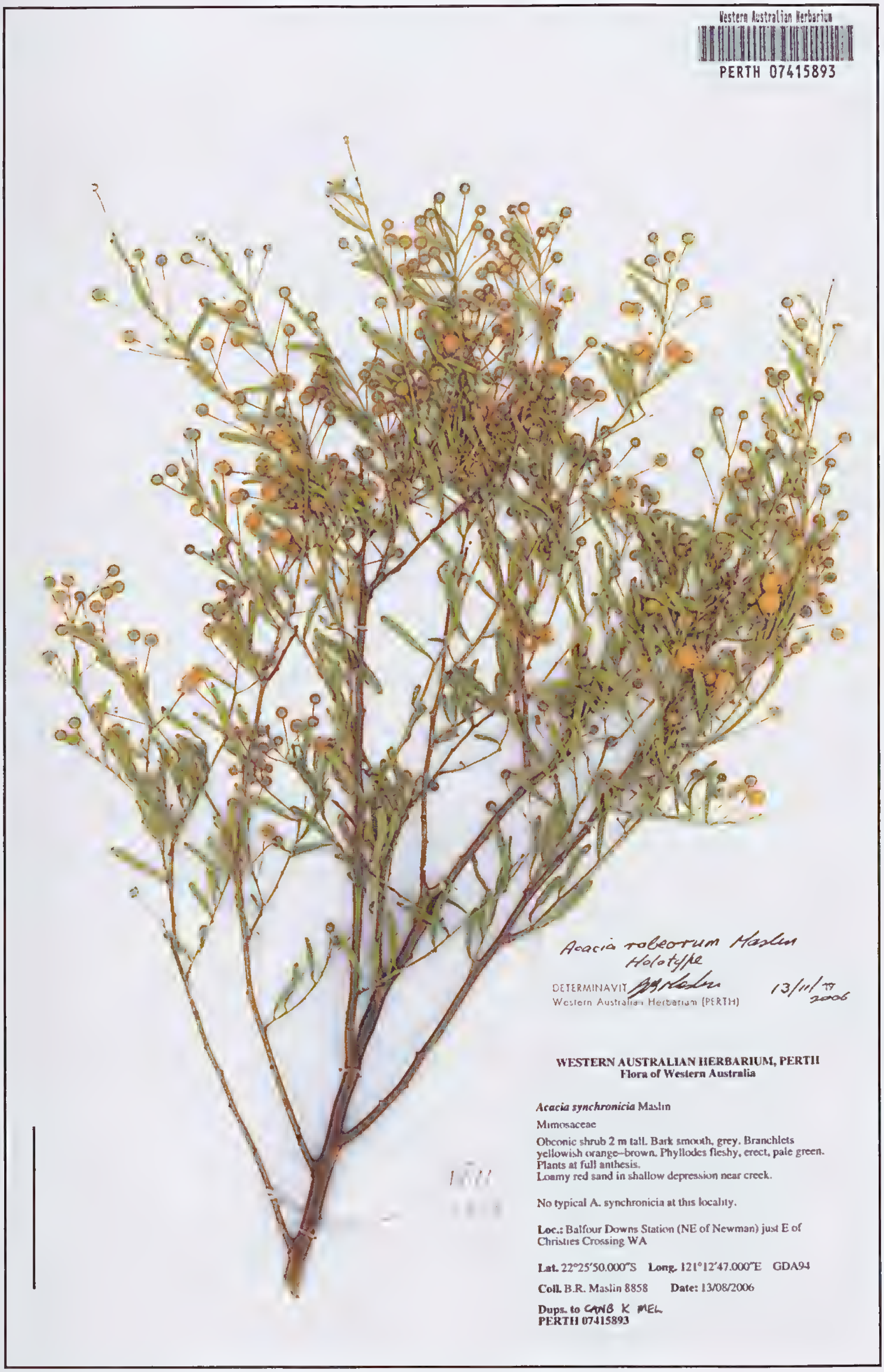
Diffuse, spreading, openly branched, multi-stemmed, glabrous *shrubs* 2–3 m tall, main stems slightly crooked, crowns not dense. *Bark* grey on main stems, light bronze on upper branches, smooth. *Branchlets* terete, very obscurely ribbed, yellowish to pale orange-brown or bronze, not pruinose. *Stipules* spiny, present on young plants but normally absent or very few on mature plants, 1.5–3(–4) mm long. *Phyllodes* linear to narrowly oblong or linear-oblanceolate, 15–25(–35) mm long, (1–)2–3(–4) mm wide, l:w = (5–)6–10(–14), rather thick, fleshy and breaking with a clean snap upon bending (when fresh), longitudinally wrinkled when dry, straight to shallowly incurved, characteristically bright green; *midrib* obscure or more commonly not evident, lateral veins not evident; *apices* rounded and excentrically mucronulate. *Gland* not overly prominent, situated on upper margin of phyllode 0–0.5 mm above the pulvinus, circular to elliptic, 0.4–0.5 mm long, 0.4–0.5 mm wide. *Inflorescences* simple, initiated on new shoots with a single peduncle within axil of developing phyllodes, subtending phyllodes fully developed before heads reach anthesis; *peduncles* (8–)10–17 mm long; *heads* light golden, 40–60-flowered. *Bracteoles* similar to sepals. *Flowers* 5-merous; *sepals* free, 2/3 length of petals, linear-spathulate; *petals* nerveless. *Pods* oblong to narrowly oblong, flat but rounded over the seeds along the midline, mostly straight-edged, (15–)25–40(–60) mm long, 6–8(–9) mm wide, papery, straight or slightly curved. *Seeds* transverse in the pods, obloid to ellipsoid, ovoid or globose, 3–4 mm long, 2.2–3.2 mm wide, somewhat compressed, dull or slightly shiny, uniformly black or sometimes very obscurely mottled dark brown; *areole* 'u'-shaped and very small at centre of seed; *funicle* short, thick, cream coloured, very slightly expanded into a small terminal *aril*. (Figure 6)

Characteristic features. Openly branched, glabrous *shrubs* 2–3 m tall, upper branches light bronze coloured. *Branchlets* yellowish to pale orange-brown or bronze, not pruinose. *Stipules* spiny, present on young plants but usually absent from mature plants. *Phyllodes* short and narrow (15–25(–35) × (1–)2–3(–4) mm, l:w mostly 6–10), linear to linear-oblanceolate or narrowly oblong, bright green, not pruinose, rather fleshy (fresh phyllodes breaking with a clean snap when bent), longitudinally wrinkled and midrib normally not evident when dry. *Gland* not overly prominent, 0.4–0.5 mm long. *Inflorescences* simple, initiated on new shoots with a single peduncle within axil of developing phyllodes, subtending phyllodes fully developed before heads reach anthesis; *heads* golden, 40–60- flowered. *Pods* papery, oblong to narrowly oblong, flat but rounded over seeds along midline, not or scarcely constricted between seeds. *Seeds* transverse in the pods, black, sometimes very obscurely mottled dark brown; *aril* small.

Selected specimens examined. WESTERN AUSTRALIA: The Gap, 1.4 km N of the turn-off to Christmas Pool, Paterson Range, 4 Sep. 1986, *R.J. Chinnock* 6963 (PERTH ex AD); 4.5 km S of Parngurr, Little Sandy Desert, 18 July 2001, *P.K. Latz* 17826 (NT *n.v.*, PERTH); upper Rudall River area, 2 Sep. 1971, *B.R. Maslin* 2046a (BRI, NT, PERTH – distributed as *A.* aff. *victoriae*); Ripon Hills Road (E of Marble Bar), 33.8 km E of Nullagine River, 27 May 2004, *B.R. Maslin* 8466 (PERTH); near abandoned Shay Gap mining settlement, 8 Oct. 2004, *B.R. Maslin* 8649 (MEL, PERTH); Barrow Island, 27 July 2006, *B.R. Maslin* 8804 (PERTH); Balfour Downs Station (NE of Newman), 13 Aug. 2006, *B.R. Maslin* 8865 (growing with typical variant of *A. synchronicia*) (PERTH); 16.5 km E of Warrawagine Hsd on alluvial plain of Oakover River, 28 Oct. 1995, *A.A. Mitchell* PRP924 (growing with typical variant of *A. synchronicia*) (PERTH); 11 km NNW of Mount Traine, 6 July 1984, *K.R. Newbey* 10365 (PERTH); 5 km NW of Shay Gap Settlement, 30 Oct. 1988, *L. Thomson* LXT 1180E–I (all PERTH).

Distribution and habitat. Occurs in north-west Western Australia where it ranges from the Pilbara eastwards to the Rudall River National Park in the Little Sandy Desert. In the Pilbara it extends from the vicinity of Marble Bar and Pardoo Station (at south western extremity of the Great Sandy Desert), south to Ethel Creek Station (north-east of Newman). A specimen in inflorescence bud collected on Barrow Island from a localized population of about 10 plants (*B.R. Maslin* 8804) appears to be referable to *A. robeorum*; however, future research is required to determine the provenance of these Barrow Island plants thereby confirming if they are recent naturalized introductions or indigenous to the island. Grows on skeletal sand or sandy loam (pH 6.5–7) over granite, laterite or quartz, in 'Spinifex' hummock grassland, sometimes along drainage lines.

Flowering and fruiting period. It is possible that flower initiation is dependant upon the timing and/or intensity of rainfall. Extant collections show plants in flower from August to September. Pods with mature seeds have been collected from late October to late November.



Western Australian Herbarium
PERTH 07415893

Acacia robeorum Maslin
Holotype

DETERMINAVIT
Western Australian Herbarium (PERTH)
13/11/2006

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Acacia synchronicia Maslin

Mimosaceae

Obconic shrub 2 m tall. Bark smooth, grey. Branchlets yellowish orange–brown. Phyllodes fleshy, erect, pale green. Plants at full anthesis.
Loamy red sand in shallow depression near creek.

No typical A. synchronicia at this locality.

Loc.: Balfour Downs Station (NE of Newman) just E of Christies Crossing WA

Lat. 22°25'50.000"S **Long.** 121°12'47.000"E GDA94

Coll. B.R. Maslin 8858 **Date:** 13/08/2006

Dups. to CANB K MEL
PERTH 07415893

Figure 6. Holotype of *Acacia robeorum* Maslin (PERTH 07415893), scale = 5 cm.

Conservation status. Not considered rare or endangered. This species is recorded from the Rudall River National Park and Meentheena Conservation Park.

Etymology. The species name acknowledges Robe River Iron Associates who provided generous financial support to the study of Pilbara wattles through the West Angelas Coondewanna West Environmental Offsets Agreement. This support enabled the authors to undertake a five year study of the Pilbara *Acacia* flora which has resulted not only in the present paper but also in two soon to be published books and an electronic identification aid to these species. More recently Robe River Iron Associates through its assets manager Pilbara Iron, in collaboration with two other mining companies, has provided considerable financial support to a long term study of the complex *A. aneura* (Mulga) group.

Affinities. Acacia robeorum is a member of the '*A. victoriae* group' of species (see Maslin 1992 for discussion) within *Acacia* sect. *Acacia*. Other members of this group that occur in the Pilbara include *A. aphanoclada* Maslin, *A. cuspidifolia* Maslin, *A. glaucocaesia* Domin, *A. synchronicia* Maslin and *A. victoriae* Benth. The new species is most closely related to the more widespread *A. synchronicia* with which it is sometimes sympatric. The main distinguishing features between the two are given in Table 1 below. In the field *A. robeorum* is easily distinguished from *A. synchronicia* by its bright green, non-pruinose phyllodes which are thicker and more fleshy (they break with a clean snap when bent), and its yellowish to pale orange-brown or bronze, non-pruinose branchlets; in *A. synchronicia* the phyllodes are grey-green to glaucous and sometimes pruinose, more thinly textured (they do not break with a clean snap when bent) and the branchlets are darker coloured and commonly lightly pruinose at their extremities. Furthermore, *A. robeorum* commences flowering a month or more before *A. synchronicia*. The phyllodes of *A. robeorum* are normally narrower than those of *A. synchronicia*, however, there is overlap in this character and plants with phyllodes 3–4 mm wide need to be carefully examined in order to apply the names accurately. In *A. robeorum* the phyllodes are always clearly wrinkled when dry, their midrib and lateral nerves are either very obscure or superficially absent and the basal gland is not overly prominent. In narrow phyllode forms of *A. synchronicia* the dry phyllodes may also sometimes be wrinkled (but more finely so) with the nerves obscure or superficially absent, however, the basal gland is larger and more prominent. Furthermore, *A. synchronicia* often has some inflorescences which are paired within the phyllode axils (always single in *A. robeorum*), the seeds are mottled (not often mottled in *A. robeorum*), the pods are often slightly broader, the spiny stipules are generally longer (although on mature plants of both species it is not uncommon to find specimens without any stipules at all) and the phyllodes of the two species are differently shaped (Table 1).

Notes. The species was treated as *A.* aff. *victoriae* by Maslin (1981: 131) and as a narrow phyllode variant of *A. synchronicia* by Maslin (1992: 304, 2001: 379). *Acacia robeorum*, unlike its close relative *A. synchronicia*, is not a troublesome (increaser) plant for pastoralists in the Pilbara.

Acacia steedmanii Maiden & Blakely subsp. **borealis** Maslin, *subsp. nov.*

Frutices vel arbores parvi, multicaules, 1.5–4(–5) m alti, corticis et ramis conspicue pruinosis (saltem plantis juvenibus). *Phyllodia* anguste elliptica vel oblanceolata, (4–)5–8(–10) cm longa, (6–)8–15(–20) mm lata, tenue texturata, glabra, costa et nervis marginalibus satis prominentibus, nervis lateralibus aliquantum perspicuis in statu sicco, manifeste anastomosantibus, apicibus plerumque obtusis, glandibus 2–3 supra margine superiore positis. *Racemi* 10–40 mm longi; *capitula* concinna, fragranti, 40–50 florifera; *pedunculi* 2–4 mm longi, glabri, aliquantum crassi, in statu sicco leviter vel aliquantum grosse longitudinaliter corrugati. *Legumina* linearia, 4–12 cm longa, plerumque 5–6 mm lata, glabra, supra seminis leviter elevata, plerumque inter semina leviter constricta, tenue texturata, atro brunnea. *Semina* 4.5–6 mm longa, 2.5–3 mm lata, a funiculo cremeo omnino circumdata.

Table 1. Differences between *A. robeorum* and *A. synchronicia*

Character	*Acacia robeorum*	*Acacia synchronicia*
Branchlets (extremities; best observed when fresh)	Not pruinose. Yellowish to pale orange-brown or bronze.	Often lightly or conspicuously pruinose. Grey to light brown or greenish.
Spiny stipules (mature plants)	Absent or few; inconspicuous. 1.5–3(–4) mm long.	Absent or few and conspicuous. 3–10 mm long.
Gland	Not overly conspicuous. 0.4–0.5 mm long and the same across.	Rather conspicuous. (0.5–)0.7–1.3 mm long; 0.5–1 mm wide.
Phyllodes		
– width	(1–)2–3(–4) mm wide.	3–7 mm wide (8–11 mm in broad phyllode variant).
– shape	Linear to narrowly oblong or linear-oblanceolate.	Elliptic to narrowly elliptic or oblong-oblanceolate, infrequently narrowly oblong.
– colour	Bright green; not pruinose.	Glaucous to sub-glaucous, grey-green or silvery grey (pale green on new shoots).
– texture	Thick & fleshy (fresh); wrinkled when dry.	Thin or sub-fleshy when fresh; smooth or sometimes finely wrinkled when dry.
– midrib & lateral nerves	Absent or very obscure.	Evident (but not overly prominent), obscure or absent when phyllodes very narrow.
Inflorescences	Single in axil of phyllodes.	1 or 2 in axil of phyllodes.
Pod width	6–8(–9) mm wide.	(8–)9–12 mm wide.
Seeds	Black, not mottled or sometimes very obscurely mottled dark brown.	Mottled black and either yellow or light brown.
Flowering period	August to September.	September to December (Pilbara) but may commence in June/July in Kimberley.
Distribution	Pilbara to Rudall River National Park, Western Australia.	Widespread in Western Australia from Kimberley to Murchison district (including Pilbara), extending east to Northern Territory.

Typus: Little Sandy Desert, 8.2 km north-west of Cooma Well, 31.4 km south-south-west of Burranbar Pool on Savory Creek, 28.2 km east-south-east of Weelarrana Homestead, 22.5 km north-north-east of Moffetah Well, 12 October 1996, *S. van Leeuwen* 2858 (*holo*: PERTH 06782248; *iso*: K, MEL).

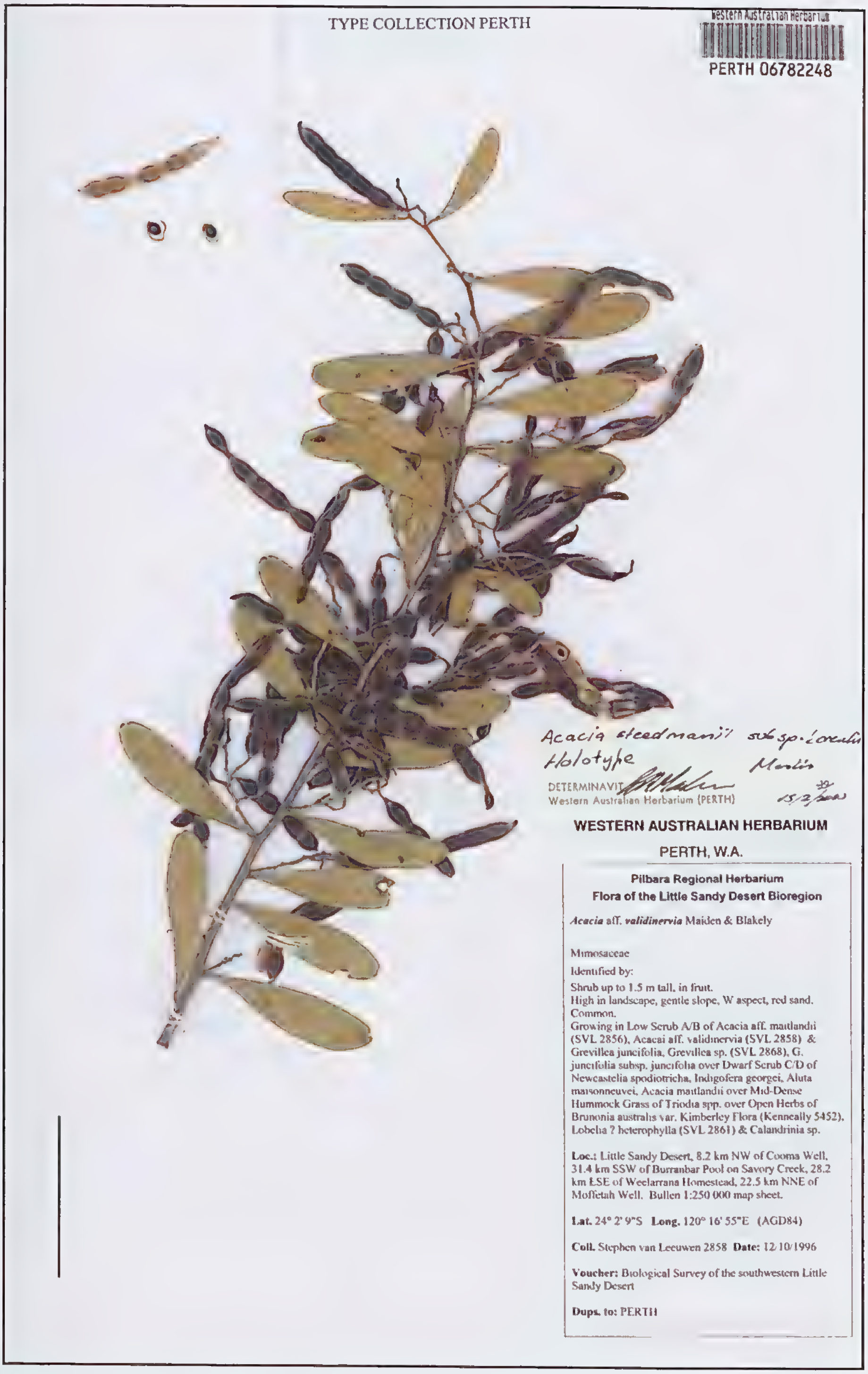
Acacia steedmanii sensu Maslin, *non* Maiden & Blakely (1928) in J. Jessup, *Fl. Central Australia* p.132 (1981).

Acacia validinervia Maiden & Blakely (Pilbara variant) *sensu* Maslin, *Fl. Australia* 11A: 279, figs 18D-F (2001).

Obconic *shrubs* or small *trees* 1.5–4(–5) m tall, crown rounded and open or dense, with numerous, slender, erect, main stems arising from ground level. *Bark* smooth and conspicuously pruinose on young plants, with age becoming grey and fibrous towards base of stems (where it more or less forms a stocking) with the upper branches red or yellow and frequently pruinose. *Branchlets* glabrous, slightly to moderately pruinose. *Phyllodes* narrowly elliptic to oblanceolate, uniformly and gradually narrowed towards the base, (4–)5–8(–10) cm long, (6–)8–15(–20) mm wide, rarely to 28 mm wide at the Rudall River (located outside the Pilbara region), thinly coriaceous, mostly wide-spreading, normally straight but a few shallowly recurved, glabrous, green or sub-glaucous; *midrib* and marginal nerves fairly prominent, lateral veins scarcely visible when fresh (except with transmitted light) but becoming evident upon drying, openly anastomosing (deflexed at their ends to intersect the marginal nerves); *apices* somewhat abruptly narrowed and obtuse, very rarely acute; *pulvinus* distinct, 4–7 mm long. *Glands* 2 or 3 on upper margin of phyllodes, the lowermost 0–3 mm above the pulvinus and normally 1 or 2 additional, often slightly raised glands near or above the centre of the phyllode. *Inflorescences* racemose or sometimes paniculate (especially at ends of branchlets); *racemes* 10–40 mm long, the axes glabrous; *peduncles* 2–4 mm long, glabrous, rather stout, finely to rather coarsely longitudinally wrinkled when dry; *heads* showy and fragrant, globular, 5–6.5 mm in diameter, bright golden, containing 40–50 densely arranged flowers. *Bracteoles* light- to mid-brown. *Flowers* 5-merous; *calyx* 3/4 length of corolla, very shortly dissected into inflexed, minutely ciliolate lobes; *calyx tube* glabrous, dark red-brown when dry; *petals c.* 1.6 mm long, glabrous, 1-nerved. *Pods* linear, gently raised over seeds and normally slightly constricted between them (occasional deep constrictions occur on some pods), 4–12 cm long, usually 5–6 mm wide (see note under *Variation* below), with up to 12 seeds per pod, firmly chartaceous, straight to slightly curved, glabrous, dark brown. *Seeds* longitudinal in the pods, obloid-ellipsoid, 4.5–6 mm long, 2.5–3 mm wide, slightly shiny, black; *funicle* thread-like, cream-coloured, completely encircling the seed in a single or double fold (expanded length 30–40 mm long); *aril* cream-coloured. (Figure 7)

Characteristic features. Multi-stemmed, glabrous *shrubs* or small *trees*, the stems and branches conspicuously pruinose (at least on young plants). *Phyllodes* narrowly elliptic to oblanceolate, gradually narrowed towards the base, thin-textured, midrib and marginal nerves fairly prominent, lateral veins somewhat evident upon drying and openly anastomosing, apices normally obtuse. *Glands* 2 or 3 on upper margin of phyllodes. *Racemes* 10–40 mm long; *heads* showy and fragrant, 40–50-flowered; *peduncles* short (2–4 mm long), glabrous, rather stout, finely to rather coarsely longitudinally wrinkled when dry. *Pods* linear, gently raised over seeds and normally slightly constricted between them, mostly 5–6 mm wide, thin-textured, dark brown. *Seeds* 4.5–6 mm long, completely encircled by a cream-coloured *funicle* 30–40 mm long (expanded length).

Selected specimens examined. WESTERN AUSTRALIA: 3 mi [4.8 km] down Canning Stock Route from Pierre Spring [just east of Carnarvon Range], Aug. 1964, *W.H. Butler, R. Aitken* and *D. Hutchison* HA65 (PERTH); about 0.7 mi [1.1 km] SE of Curran Curran rockhole, near Rudall River, 23 May



Acacia steedmanii subsp. borealis
Holotype
Maslin
DETERMINAVIT B.R. Maslin
Western Australian Herbarium (PERTH)
15/2/2000

WESTERN AUSTRALIAN HERBARIUM

PERTH, W.A.

Pilbara Regional Herbarium
Flora of the Little Sandy Desert Bioregion

Acacia* aff. *validinervia Maiden & Blakely

Mimosaceae

Identified by:

Shrub up to 1.5 m tall, in fruit.
High in landscape, gentle slope, W aspect, red sand.
Common.
Growing in Low Scrub A/B of Acacia aff. maitlandii (SVL 2856), Acacai aff. validinervia (SVL 2858) & Grevillea juncifolia, Grevillea sp. (SVL 2868), G. juncifolia subsp. juncifolia over Dwarf Scrub C/D of Newcastelia spodiotricha, Indigofera georgei, Aluta maisonneuvei, Acacia maitlandii over Mid-Dense Hummock Grass of Triodia spp. over Open Herbs of Brunonia australis var. Kimberley Flora (Kenneally 5452), Lobelia ? heterophylla (SVL 2861) & Calandrinia sp.

Loc.: Little Sandy Desert, 8.2 km NW of Cooma Well, 31.4 km SSW of Burranbar Pool on Savory Creek, 28.2 km ESE of Weelarrana Homestead, 22.5 km NNE of Moffetah Well. Bullen 1:250 000 map sheet.

Lat. 24° 2' 9"S **Long.** 120° 16' 55"E (AGD84)

Coll. Stephen van Leeuwen 2858 **Date:** 12/10/1996

Voucher: Biological Survey of the southwestern Little Sandy Desert

Dups. to: PERTH

Figure 7. Holotype of *Acacia steedmanii* Maiden & Blakely subsp. *borealis* Maslin (PERTH 06782248), scale = 5 cm.

1971, *A.S. George* 10839 (PERTH, TLF); upper Rudall River area near Curran Curran rockhole, 6 Sep. 1971, *B.R. Maslin* 2139 (CANB, G, K, MEL, NY, PERTH); 104 km NW of Newman on the road to Juna Downs, 9 July 1980, *B.R. Maslin* 4626 (BRI, CANB, MEL, NY, PERTH – distributed in 1980 as *A. validinervia*); about 10 km NE of Juna Downs Homestead on road to Karijini National Park, 5 Sep. 1995, *A.A. Mitchell* PRP 673 (PERTH); Little Sandy Desert, 22 Apr. 1979, *A.S. Mitchell* 514 (NT, PERTH); near Ranger's residence, Hamersley Range National Park, Aug. 1980, *E. & I. Solomon* 1 (PERTH); junction of Circular Pool Road and Juna Downs Road, Hamersley Range National Park, 20 Oct. 1988, *L. Thomson* LXT 1114 (PERTH); Mt Meharry, southern spur of main hill, *c.* 500 m S of trig station, 15.2 km SW of Goldsworthy's Packsaddle camp, 19 Apr. 1990, *S. van Leeuwen* 686 (PERTH); Munjina gorge area, 8 July 1983, *A.S. Weston* 13473A (PERTH).

Distribution and ecology. Occurs in the Pilbara region (restricted to the central Hamersley Range area) and further east where it is scattered though the Little Sandy Desert to the Rudall River National Park and near the Carnarvon Range. Grows in red sand on sandplains, on rocky scree slopes and around the edges of steep breakaways and cliffs. In the Pilbara it is found in skeletal, red, stony clay-loam over massive banded ironstone. It shows its best development (sometimes forming thickets) along floodplains, drainage lines and in water gaining sites. It is common along road verges and similar water gaining sites in many of the places where it occurs.

Flowering and fruiting period. Flowering extends from late June to early September with the main flush in July and August. Pods with mature seeds have been collected in mid-October and it would be expected that mature fruits would be found on the plants until November.

Conservation status. Not considered rare or endangered. This species is common within the Karijini National Park and has also been recorded from the Rudall River National Park.

Etymology. The species is named in honour of Harry Steedman (Hall 1978: 122). The subspecies name is derived from the Latin *borealis* (northern) and alludes to the distribution of this taxon relative to the typical subspecies.

Common name. This subspecies is sometimes called Roadside Wattle in the Pilbara, however, a more appropriate common name might be Northern Steedman's Wattle.

Affinities. Acacia steedmanii is a member of *Acacia* section *Acacia.* Subspecies *borealis* is most readily distinguished from the more southerly distributed typical subspecies (which occurs in the wheatbelt and adjacent goldfield region of south-west W.A.) by its longer seeds which have a longer funicle (in subsp. *steedmanii* the seeds are 3.5–4 mm long and the funicle is 8–12 mm long and extends only to about half way around the seed). The phyllodes of subsp. *steedmanii* are often more abruptly narrowed at the base than those of subsp. *borealis*, its peduncles are generally slightly longer (mostly 4–6 mm) and its heads generally have fewer flowers (mostly 30–40). Although the racemes of subsp. *steedmanii* are often about as long as subsp. *borealis* they normally range from 25–50 mm long with some extending up to 120 mm.

Subspecies *borealis* is related to *A. validinervia* which occurs further east in the ranges of central Australia (in far eastern W.A., north-west S.A. and central N.T.), which is distinguished by its thicker, generally wider phyllodes (mostly 15–40 mm) with a more pronounced reticulum, heads with more numerous flowers (50–80) and darker-coloured bracteoles, usually wider pods (7–8 mm), and wider seeds (3–5 mm) which are encircled by a generally shorter funicle (6–30 mm long, expanded length).

As noted below under *Variation*, the new subspecies had in the past been referred to *A. validinervia*, based primarily on the aberrant specimen (now attributed to subsp. *borealis*) with wide pods from the Little Sandy Desert at Rudall River.

Subspecies *borealis* is also related to an undescribed entity from the Little Sandy Desert that was called *A.* aff. *validinervia* in *Flora of Central Australia* (Maslin 1981: 133) and noted as a variant under *A. validinervia* in the *Flora of Australia* (Maslin 2001: 279). This entity is currently given the phrase name *Acacia* sp. Lake Disappointment (S. van Leeuwen 2865) and is characterized by its long phyllodes, large flower heads and spindly, whipstick growth form.

Variation. The only significant variant known is a specimen from the Rudall River area (*B.R. Maslin* 2139) that has pods 8–10 mm wide (twice the normal width of those found elsewhere on subsp. *borealis*). However, the seeds failed to develop and it is not known if this specimen represents a 'good' biological entity or whether unknown factors have caused the pods to become atypically wide. This specimen was described as *A. steedmanii* Maiden & Blakely in the *Flora of Central Australia* (Maslin 1981: 132) and was noted as a variant under *A. validinervia* Maiden & Blakely in the *Flora of Australia* (Maslin 2001: 279 – where *A.S. George* 10839 was erroneously cited as the voucher).

Notes. Subspecies *borealis* can resprout from a basal woody rootstock following fire. It probably has a relatively fast growth rate and regenerates from seed.

This is an attractive species with its white stems (at least when plants are young) and showy, fragrant, golden heads, and as such would be well-suited for amenity plantings and in home gardens in arid areas.

Acacia subcontorta Maslin, *sp. nov.*

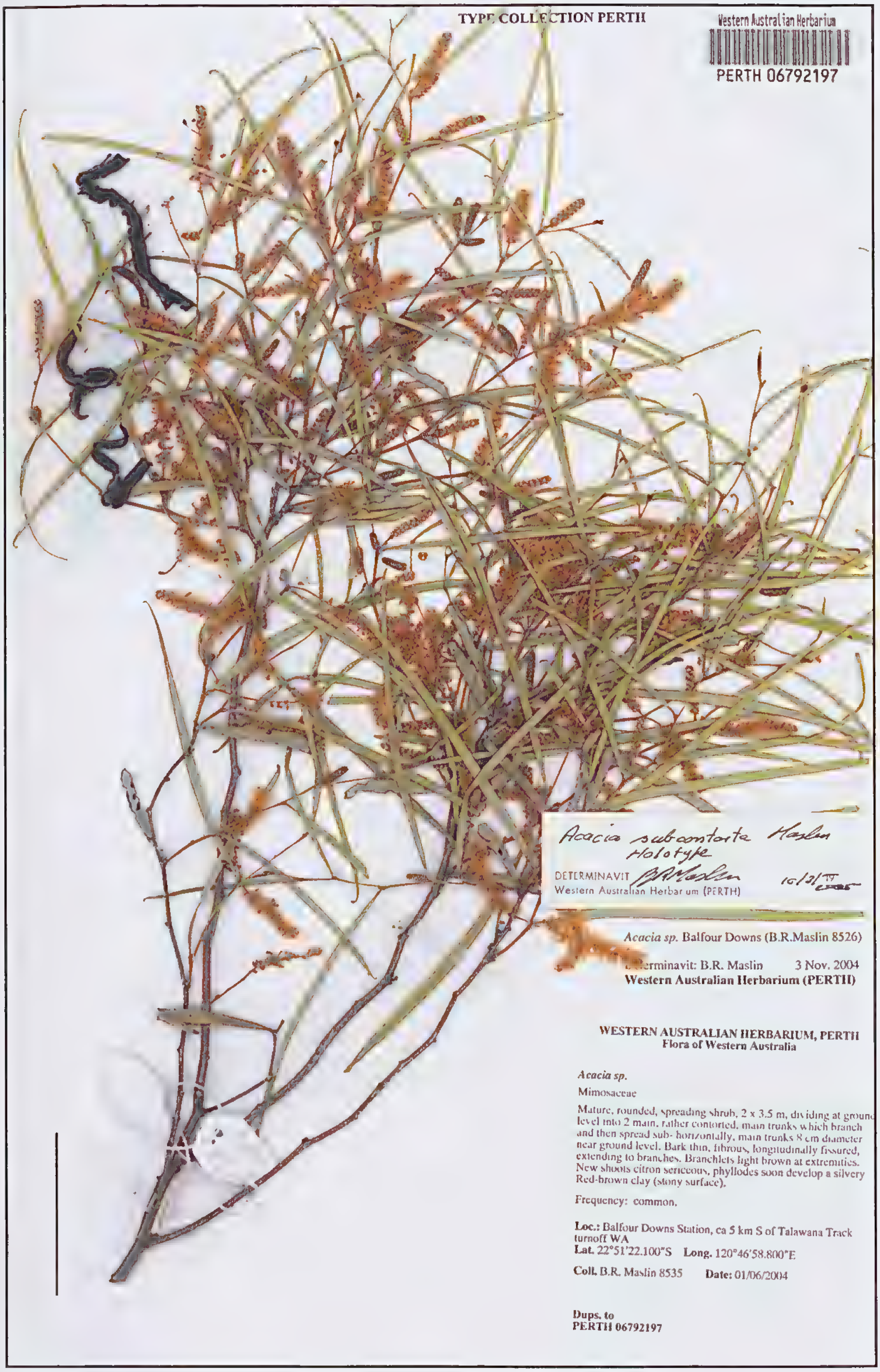
Arbores vel *frutices* effusi (1–)2–6(–8) m alti; *caules* aliquantum contorti; *rami* principales aliquantum contorti, horizontaliter effusi; *plantae juvenes* obconicae capitula sub-rotunda densa. *Ramuli* glabri (praeter surculos novos et interdum in axilli phyllodiorum maturum). Surculi novi resinosi pilis appressis pallido luteis ut argenteo albis mox mutatis. *Phyllodia* linearia vel angustissimo elliptica, 6–11 cm longa, (2–)3–5(–8) mm lata, moderate coriacea vel sub-rigida, recta vel leviter recurvata, *phyllodia adulescentia* cinereo-viridia vel subcaerulea indumento pilis appresso argenteo-albis, maturitate viridia et glabra vel subglabra, subtiliter multi-striata nervis numerosis parallelis ornata, nervo marginali resinoso et luteolo et rubro-brunneo; *apices* acuti vel acuminati, curvati vel uncinati. *Inflorescentiae* plerumque simplices; *pedunculi* 2–6(–8) mm longi, in statu florescentia sparse vel modice dense pilosi, in statu fructo glabri vel sub-glabri; *spicae* aureae vel pallido aureae, 20–35 mm longae, gemmis leviter resinosis; *receptaculum* pilis sparsis vel modice densis effusis nitidis albis vel pallido luteis (rare pallido aureis) ornatum sed in fructu glabrum. *Flores* 5-meri; *calyx* ad dimidium dissectus; *petala* glabra. *Legumina* 1–7 cm longa, 6–9 mm lata, anguste oblonga vel linearia, turgida vel sub-teretia, coriaceo-crustacea vel lignosa, glabra vel (in statu juvenili) appresse pilosa. *Semina* in legumine longitudinalia, oblonga vel elliptica, 5–7 mm longa, 4–5 mm lata, atro brunnea vel nigra; *arillus* ceraceus, albus.

Typus: Balfour Downs Station, *c.* 15 km south of Talawana Track turnoff, 22° 51' 22.1" S, 120° 46' 58.8" E, Western Australia, 1 June 2004, *B.R. Maslin* 8535 (*holo*: PERTH 06792197; *iso*: CANB, G, K, MEL, NSW, NY).

Acacia sp. Balfour Downs (B.R. Maslin 8526), in Council of Heads of Australasian Herbaria, *Australian Plant Census*, http://www.anbg.gov.au/chah/apc/index.html [accessed 19 February 2008].

Multi-stemmed *shrubs or trees* (1–)2–6(–8) m tall, crowns ± rounded, sub-dense (sparser on oldest plants) and spreading (1–)3–5 m across, trunks somewhat contorted and reaching about 10–15 cm diameter at breast height, main branches somewhat contorted and ± horizontally spreading, young plants obconic with a dense sub-rounded crown. *Bark* grey, thin, fibrous and finely longitudinally fissured on trunks and main branches. *Branchlets* terete, obscurely ribbed, light brown at extremities, glabrous (except new shoots and sometimes in axil of mature phyllodes). *New shoots* green, resinous (but not sticky), pale yellow sericeous (often intermixed with some microscopic, red-brown resin hairs) when young but the hairs soon becoming silvery white, the indumentum sometimes obscured by resin when shoot is first initiated. *Stipules* caducous. *Phyllodes* linear to very narrowly elliptic, 6–11 cm long, (2–)3–5(–8) mm wide, moderately coriaceous to sub-rigid, rather wide-spreading to ascending or ± erect, straight to very shallowly recurved, commonly with a thin layer of non-sticky resin, adolescent phyllodes grey-green to bluish with a distinct silvery sheen due to an indumentum of appressed silvery white hairs (indumentum most dense on youngest phyllodes), oldest phyllodes green and glabrous or sub-glabrous; finely multistriate, anastomoses absent, the *nerves* very close together, of uniform prominence or the central one slightly more evident than the rest; *marginal nerve* discrete, resinous, yellowish or red-brown; *apices* acute to acuminate, curved to uncinate, innocuous; *pulvinus* 2–3 mm long, yellow to yellow-brown and transversely wrinkled when dry. *Gland* not prominent but sometimes slightly raised above margin, situated on upper margin of phyllode 0.5–1(–3) mm above the pulvinus, circular, 0.3–0.6 mm in diameter, often brown (when dry). *Inflorescences* simple or sometimes rudimentary racemes (with 2 spikes) to 2 mm long; *peduncles* 2–6(–8) mm long, sparsely to moderately densely hairy when in flower (hairs mostly appressed to sub-appressed but sometimes patent), glabrous or sub-glabrous when in fruit; *spikes* numerous and showy, 20–35 mm long, golden to light golden, buds slightly resinous and densely flowered (i.e. flowers close together) but becoming sub-densely flowered at anthesis (more space between the individual flowers so that the receptacle is often seen); *receptacle* puberulous with sparse to dense, spreading, white or pale yellow (rarely light golden) hairs but often glabrous when in fruit. *Bracteoles* linear-spathulate, *c.* 1 mm long, equal in length to calyx, the claws linear, the laminae *c.* 0.5 mm wide, inflexed and slightly thickened. *Flowers* 5-merous, rather small (petals *c.* 1.5 mm long), slightly resinous (but not sticky); *calyx* 1/3 to 1/2 length of corolla, dissected for *c.* 1/2 its length into oblong, sparsely hairy lobes which are inflexed and slightly thickened abaxially at apex, as flowers mature the sepals may sometimes irregularly split (sometimes to the base); *petals* glabrous, nerveless or very obscurely 1-nerved; *ovary* densely white tomentulose. *Pods* narrowly oblong to linear, flat but turgid to ± sub-terete, straight-edged or very shallowly constricted between seeds (occasional deep constrictions may occur on a few pods), 1–7 cm long, 6–9 mm wide, coriaceous-crustaceous to woody, glabrous or appressed-hairy (hairs white, moderately dense to sub-sparse and often embedded in a resinous, non-sticky, matrix when young), straight to shallowly or strongly curved, occasionally irregularly sigmoid or openly coiled, dark brown; *marginal nerve* not or scarcely thickened, yellow to light brown. *Seeds* longitudinal in pods, obloid to ellipsoid, large (5–7 mm long, 4–5 mm wide), compressed (3 mm thick), very dark brown to almost black, dull except slightly shiny at the centre (associated with areole); *areole* narrowly oblong to narrowly elliptic, 1.5–2 mm long, *c.* 0.7 mm wide, slightly shiny; *pleurogram* continuous, bordered by a ± obscure, narrow, very slightly raised, sometimes slightly shiny band of tissue; *funicle* filiform and folded beneath a thickened, waxy terminal *aril* which is white except light green (when fresh) at attachment to seed. (Figure 8)

Characteristic features. Multi-stemmed, spreading *shrubs* or *trees* with rather crooked stems, main branches somewhat contorted and ± horizontally spreading. *New shoots* green, resinous (but not sticky),



Acacia subcontorta Maslin
Holotype
DETERMINAVIT B.R.Maslin 10/31/II 2005
Western Australian Herbarium (PERTH)

Acacia sp. Balfour Downs (B.R.Maslin 8526)
Determinavit: B.R. Maslin 3 Nov. 2004
Western Australian Herbarium (PERTH)

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Acacia sp.

Mimosaceae

Mature, rounded, spreading shrub, 2 x 3.5 m, dividing at ground level into 2 main, rather contorted, main trunks which branch and then spread sub- horizontally, main trunks 8 cm diameter near ground level. Bark thin, fibrous, longitudinally fissured, extending to branches. Branchlets light brown at extremities. New shoots citron sericeous, phyllodes soon develop a silvery Red-brown clay (stony surface).

Frequency: common.

Loc.: Balfour Downs Station, ca 5 km S of Talawana Track turnoff WA
Lat. 22°51'22.100"S **Long.** 120°46'58.800"E

Coll. B.R. Maslin 8535 **Date:** 01/06/2004

Dups. to
PERTH 06792197

Figure 8. Holotype of *Acacia subcontorta* Maslin (PERTH 06792197), scale = 5 cm.

pale yellow sericeous when first initiated with the hairs soon becoming silvery white, indumentum sometimes obscured by resin when shoot is first initiated. *Phyllodes* linear to very narrowly elliptic, mostly 3–5 mm wide, moderately coriaceous to sub-rigid, straight to very shallowly recurved, adolescent phyllodes grey-green to bluish with a distinct silvery sheen due to an indumentum of appressed silvery white hairs (densest on youngest phyllodes), ageing green and glabrous or sub-glabrous; finely multistriate with numerous, parallel *nerves*, marginal nerve resinous and yellowish or red-brown, apices acute to acuminate and curved to uncinate. *Peduncles* relatively short (2–6(–8) mm long); *spikes* showy, golden, buds slightly resinous; *receptacle* with sparse to moderately dense spreading white or pale yellow (rarely light golden) hairs but often glabrous when in fruit. *Pods* 6–9 mm wide, turgid to ± sub-terete, coriaceous-crustaceous to woody, glabrous or appressed white-hairy (hairs often embedded in a resin when pods young), dark brown. *Seeds* large (5–7 × 4–5 mm), very dark brown to almost black.

Selected specimens examined. WESTERN AUSTRALIA: Gibson Desert Nature Reserve, 4 May 1999, *N. Burrows* 2/99/27 (PERTH); between Thryptomene Hill and Mt Samuel on Gunbarrel Highway, 3 July 1983, *D.J. Edinger* 106 (PERTH); Troy Creek headwaters, NW of Granite Peak Homestead, NE of Wiluna, 20 May 1999, *M. French* 844 (PERTH); Ashburton Botanical District – eastern extremity: 27.5 km NE of Carnegie Homestead on Gunbarrel Highway to Warburton, 7 Sep. 1984, *B.R. Maslin* 5640 (K, PERTH) and 5640A (NSW, NT, PERTH); Gibson Desert: about 10 km E of Mount William Lambert on Gunbarrel Highway, 8 Sep. 1984, *B.R. Maslin* 5647 (PERTH); Ethel Creek Station (NE of Newman), 61.3 km from Newman – Marble Bar road on road to Balfour Downs Station, 31 May 2004, *B.R. Maslin* 8526 (CANB, K, MEL, NSW, PERTH); about 10 km due W of Giles Point (located at W extremity of Ophthalmia Range), on 'Giles Road', 2 June 2004, *B.R. Maslin* 8550 (DNA, PERTH) and 8551 (PERTH); 12.7 km from Weelarrana Hsd on a bearing of 58 °, 20 June 1996, *A.A. Mitchell* PRP1155 (NT, PERTH); Lorna Glen Station, Oct. 1984, *K. Thomas* 2 (PERTH); 31.5 km E of Mt Ella, 29 Sep. 1998, *S. van Leeuwen* 4143 (PERTH); Balfour [Downs Station], 22 May 1983, *K. Walker* 257 (PERTH).

Distribution and ecology. Occurs in Western Australia where it has a scattered distribution from the Pilbara region south to Lorna Glen Station (about 150 km north-east of Wiluna) then east to Thryptomene Hill in the Gibson Desert (about 600 km east-north-east of Wiluna); *A. thoma* Maslin (see below) shows a somewhat similar distribution pattern. In the Pilbara region *A. subcontorta* occurs on Balfour Downs and Ethel Creek stations (north-east of Newman) and also in the Hamersley Range near Giles Point, about 150 km to the west (a similar disjunction between the Hamersley Ranges and the Balfour area also occurs in *A. bromilowiana* and *A. catenulata* subsp. *occidentalis,* see above). *Acacia subcontorta* is often common in the places where it occurs.

Within the Pilbara this species grows on stony hardpan plains that are typically characterised by very shallow red-brown loamy soils with a surface mantle of ironstone pebbles and cobbles over a consolidated ferruginous hardpan. These hardpans are typically found on gently undulating plains or between extensive Mulga groves. The hardpans tend to be characterised by overland sheet flows of water and are thus run-off sites; in the Pilbara these sites occur in the Zebra, Spearhole, Washplain and Wanna Munna Land Systems (Van Vreeswyk *et al*. 2004). Further south in the eastern Gascoyne district and adjacent deserts, *A. subcontorta* is also associated with hardpan habitats although the soils appear to be somewhat sandy, especially in the Lorna Glen and Carnegie area. These hardpans may contain calcareous elements and where drainage is more defined, or where there exists a drainage foci such as a clay pan, *A. subcontorta* may occur on the fringing sandy levee banks. Open Mulga woodlands, characteristically grove-intergrove Mulga, with limited 'Spinifex' understorey forms the typical vegetation association in which this new species occurs.

Flowering and fruiting period. Flowers from May to July and pods with mature seeds have been collected from late August to mid-October.

Conservation status. Not considered rare or endangered. Known from the Gibson Desert Nature Reserve and well represented in the proposed Mulgalands Conservation Park.

Etymology. The species name is derived from the Latin *sub* (somewhat) and *contortus* (twisted) referring to the form of the stems and main branches.

Affinities. Acacia subcontorta belongs to *Acacia* sect. *Juliflorae* and has affinities with *A. citrinoviridis* Tindale & Maslin which is common in parts of the Pilbara. *Acacia citrinoviridis*, however, is most readily distinguished by its broader pods (10–15 mm wide) which are densely citron sericeous (this colour is most evident on young pods, the hairs may turn silvery white as the pod matures); also, it has more obviously falcate phyllodes that are normally broader (mostly 7–13 mm wide) with yellow (never red) marginal nerves. The habit and habitat of *A. citrinoviridis* are also different from that of *A. subcontorta*. *Acacia citrinoviridis* normally has a single, straight main trunk, attains a height of 3.5–12(–18) m tall and is normally found on the banks and adjacent floodplains of major river systems (infrequently along minor water courses). *Acacia subcontorta* is multi-stemmed and commonly of lower stature, has somewhat contorted main branches and favours drier hardpan sites. Narrow phyllode forms of *A. catenulata* subsp. *occidentalis* may superficially resemble *A. subcontorta* (see subsp. *occidentalis* above for discussion); these two taxa are sympatric near Giles Point on the Wanna Munna Flats in the Hamersley Range, and in the absence of pods care needs to be taken not to confuse the two taxa.

Acacia subcontorta is also related to *A. xanthocarpa* R.S.Cowan & Maslin which occurs in the Murchison region south of the Pilbara and which is currently under review. Plants regarded as typical *A. xanthocarpa* are readily distinguished from *A. subcontorta* by their terete phyllodes and more thinly textured pods with an indumentum of spreading, straight or crisped yellow hairs (the hairs ageing white).

Variation. There appears to be considerable variation in the growth form of this species. In better sites (i.e. along drainage lines) it may grow to a small tree reaching 6–8 m in height (e.g. *B.R. Maslin* 8526) but on drier sites such as hardpan plains (e.g. in places on Balfour Downs Station) it appears to be more shrubby, ranging in height from 1–3 m tall. These differences in stature are most likely related to the depth of the hardpan and the ability of such soils to retain water and nutrients.

Acacia subtiliformis Maslin, *sp. nov.*

Frutices erecti, debiles, glabri, 2.5–3.5 m alti. *Ramuli* lenticellulosi. *Stipulae* persistentes, parvae, erectae, appressae, saepe in resina inclusae. *Phyllodia* asymmetricaliter oblonga vel oblongo-elliptica, parvula, 2–3.5(–5) mm longa, 1.2–1.8 mm lata, l:w = 1–2.3; *costa* non prominens; *apices* cuspide brevi gracili rigida abrupte terminati; *pulvinus* indistinctissimus. *Inflorescentiae* simpiciae; *pedunculi* 6–8 mm longi, basim ebracteati; *capitula* globosa, dense 40–50-flora. *Flores* 5-meri; *sepala* libra. *Legumina* anguste oblonga, applanata sed supra semina rotundata et plerumque inter-semina leviter constricta, 20–40 mm longa, 3–4 mm lata, firme chartacea, stipitata, acuta. *Semina* in legumen longitudinalia posita, elliptica, parva (*c.* 3 mm longa, *c.* 2 mm lata), turgida, nigra sed sordide pallido-lutea variegata; *funiculus* filiformis, exarillatus.

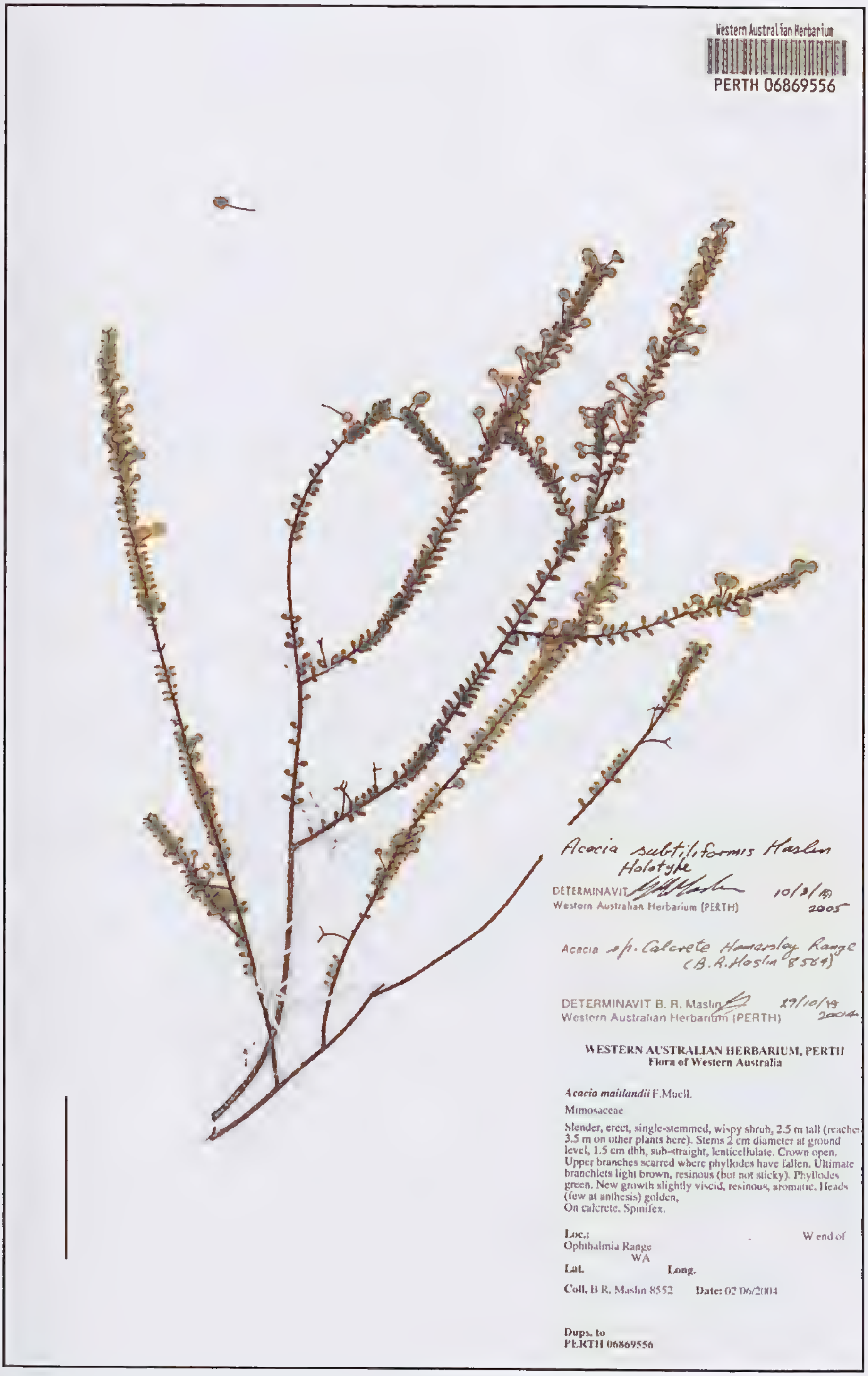
Typus: Ophthalmia Range, Western Australia [precise locality withheld for conservation reasons], 2 June 2004, *B.R. Maslin* 8552 (*holo*: PERTH 06869556; *iso*: K, MEL).

Acacia sp. Calcrete Hamersley Range (B.R. Maslin 8564), in Council of Heads of Australasian Herbaria, http://www.anbg.gov.au/chah/apc/index.html [accessed 18 February 2008].

Erect, spindly (wispy), single-stemmed *shrubs* 2.5–3.5 m tall, crown openly branched, stems about 1.5 cm diameter at breast height, the upper branches scarred where phyllodes have fallen. *Branchlets* terete, glabrous, light brown or red-brown but soon ageing grey, finely ribbed (rib most evident immediately below insertion of phyllodes), lenticellate (lenticels scattered, circular, dull yellow), resinous (but not sticky). *Stipules* persistent, narrowly triangular, 0.7–1.5 mm long, 0.2–0.3 mm wide at base, erect and appressed to branchlets, often enveloped and obscured by resin, dark brown. *Phyllodes* asymmetrically oblong to oblong-elliptic, lower margin ± straight, upper margin often shallowly convex, very small, 2–3.5(–5) mm long (include mucro), 1.2–1.8 mm wide, l:w = 1–2.3, sub-crowded, slightly thickened, wide-spreading, straight, glabrous, green; *midrib* not prominent, slightly raised (when dry) and extending from pulvinus to mucro, often with a less pronounced nerve parallel to midrib on its upper side (rarely also on lower side); *apices* rounded and abruptly terminated in a short (0.3–0.5 mm long) but distinct, excentric, slender, rigid, subulate, pungent, straight or shallowly recurved, brown point; *pulvinus* very indistinct (rudimentary or seemingly absent), to 0.2 mm long, yellowish. *Gland* not prominent, situated on upper margin of phyllode 1–1.5 mm above the base (near to, or below, centre of phyllode). *Inflorescences* simple, 1 per axil; *peduncles* glabrous, 6–8 mm long, dark red (at least when fresh), base ebracteate; *heads* globular, *c.* 5 mm in diameter (when dry), densely 40–50- flowered, golden. *Bracteoles* sub-peltate, 1–1.2 mm long, the claws linear, puberulous on margins and adaxially, the laminae sub-circular, inflexed at right angles to claw, slightly thickened and fimbriolate (hairs straight and silvery white). *Flowers* 5-merous; *sepals* 2/3–3/4 length of petals, free to base, shape, size and indumentum same as bracteoles; *petals* 1.5 mm long, glabrous, free, very obscurely nerved; *ovary* glabrous. *Pods* narrowly oblong, flattened but rounded over seeds, ± straight-edged or slightly constricted between seeds, 20–40 mm long, 3–4 mm wide, firmly chartaceous, straight, glabrous, slightly shiny, brown to greyish brown, sometimes slightly pruinose, the marginal nerve narrow, stipitate (stipe *c.* 3 mm long), apex acute. *Seeds* longitudinal in pods, ellipsoid, small (about 3 mm long and 2 mm wide), turgid (2 mm thick), slightly shiny, black but mottled dull pale yellow, with a narrow band of dull pale yellow tissue bordering the pleurogram and around the periphery of the seed; *areole* very small (*c.* 0.3 mm long and the same across), located near centre of seed, dull yellow; *pleurogram* very obscure, 'u'-shaped; *funicle* filiform, not expanded into an *aril*, *c.* 2 mm long, reddish brown. (Figure 9)

Characteristic features. Erect, spindly, wispy, single-stemmed, glabrous *shrubs*, the upper branches scarred where phyllodes have fallen. *Branchlets* lenticellate, resinous (but not sticky). *Stipules* persistent, very small, erect, appressed to branchlet and often obscured by resin. *Phyllodes* asymmetrically oblong to oblong-elliptic, lower margin ± straight, upper margin often shallowly convex, very small (2–3.5(–5) × 1.2–1.8 mm, l:w = 1–2.3), sub-crowded, green; *midrib* not prominent; *apices* terminated in a short but distinct, excentric, slender pungent point; *pulvinus* very indistinct. *Inflorescences* simple, 1 per axil; *peduncles* dark red (when fresh), base ebracteate; *heads* globular, 40–50-flowered. *Sepals* free. *Pods* narrowly oblong, flattened but rounded over seeds and ± straight-edged or slightly constricted between seed, rather small (20–40 × 3–4 mm), firmly chartaceous, stipitate. *Seeds* small (*c.* 3 × 2 mm), black but mottled pale yellow, areole very small (*c.* 0.3 × 0.3 mm), *funicle* filiform and not expanded into an aril.

Selected specimens examined. WESTERN AUSTRALIA: [precise localities withheld for conservation reasons] Hamersley Range: 8 Sep. 1995, *N.E. Casson & E.M. Mattiske* MCPL 1060 (PERTH); Oct. 1992, *J. Fox* 7626 (PERTH, photocopy of sheet ex Curtin University); 2 June 2004, *B.R. Maslin* 8552 (K, MEL, PERTH); 2 June 2004, *B.R. Maslin* 8564 (PERTH); 13 Oct. 2004, *B.R. Maslin* 8699 (MEL, PERTH); 2 Aug. 2006, *E. Thoma* 1153 (NSW, PERTH).



Western Australian Herbarium
PERTH 06869556

Acacia subtiliformis Maslin
Holotype
DETERMINAVIT *10/3/19*
Western Australian Herbarium (PERTH) *2005*

Acacia *sp. Calcrete Hamersley Range (B.R.Maslin 8564)*

DETERMINAVIT B. R. Maslin *29/10/19*
Western Australian Herbarium (PERTH) *2004*

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Acacia maitlandii F.Muell.

Mimosaceae

Slender, erect, single-stemmed, wispy shrub, 2.5 m tall (reache 3.5 m on other plants here). Stems 2 cm diameter at ground level, 1.5 cm dbh, sub-straight, lenticellulate. Crown open. Upper branches scarred where phyllodes have fallen. Ultimate branchlets light brown, resinous (but not sticky). Phyllodes green. New growth slightly viscid, resinous, aromatic. Heads (few at anthesis) golden,
On calcrete. Spinifex.

Loc.: W end of
Ophthalmia Range
WA
Lat. **Long.**

Coll. B R. Maslin 8552 **Date:** 02 06/2004

Dups. to
PERTH 06869556

Figure 9. Holotype of *Acacia subtiliformis* Maslin (PERTH 06869556), scale = 5 cm.

Distribution and ecology. Known from only six populations within the Hamersley Range, namely, four from the Hancock Range and two in the Ophthalmia Range. See under *Conservation status* below for population sizes at these localities. *Acacia subtililiformis* occurs in low undulating country on calcareous rises adjacent to drainage lines. Soil analysed from one of the Ophthalmia Range populations was shown to be very low in total phosphorus, relatively high in exchangeable calcium and measured pH 8.9 (S. van Leeuwen, pers. comm.). The dominant vegetation at most sites is characterised by *Eucalyptus* mallees over scattered *Melaleuca* and *Petalostylis* shrubs over scattered hard 'Spinifex'.

Flowering and fruiting period. Flowers in July and August. Pods with mature seeds have been collected in mid-October.

Conservation status. Acacia subtiliformis is listed as Priority Three under DEC Conservation Codes for Western Australian Flora (Atkins 2008). Current evidence shows this species as having a very restricted distribution within the Hamersley Range where it is known from only six disjunct populations (see *Distribution and ecology* above), none of which is located within the Karijini National Park but two of which are within the proposed Mulgalands Conservation Park. Plant numbers exceed 10,000 in one of the Hancock Range populations and 100 in another; more than 10,000 plants occur in one of the Ophthalmia Range populations. Three of the extant populations are located within the disturbance footprint of existing iron ore mining operations or the infrastructure corridors associated with such operations and the largest known population in the Hancock Range could be adversely impacted by changes in surface and underground hydrological regimes associated with mine dewatering and reinjection.

Etymology. The species name is derived from the Latin *subtilis* (thin, slender, fine) and *forma* (shape, figure) in reference to the characteristic wispy, spindly growth form of the species.

Affinities. A member of *Acacia* sect. *Acacia* and most closely related to *A. minutissima* (see above); these two species are closely related to *A. maitlandii* which is readily distinguished from both by its much longer phyllodes (i.e. 7–25 mm). See *A. minutissima* above for further discussion.

Notes. Acacia subtiliformis has a very distinctive wispy growth form and there are a number of taxa scattered throughout the Pilbara region which are similar in this regard. Some, like *A. aphanoclada*, *A. orthocarpa* F.Muell. and *A. subtiliformis* warrant formal taxonomic status because they possess characters other than growth form which set them apart from their closest relatives. However, wispy variants are also known to occur in *A. bivenosa* DC. and *A. hamersleyensis* but based on current knowledge these entities appear not to warrant formal recognition.

Acacia thoma Maslin, *sp. nov.*

Frutices multicaules (1.5–)2–3.5 m alti. *Ramuli* versus extremitates argenteo sericei. *Phyllodia* angustissime elliptica, interdum anguste linearia, 5–8(–10) cm longa, 2–3(–4) mm lata, erecta, sub-rigida, recta vel leviter incurva, argenteo pallido ravido viridia, pilis argenteo appressis ut demum limitatus ad inter-nervos, subtiliter et uniformiter multi-striata; *apices* innocui. *Inflorescentiae* simplices; *pedunculi* 3–6 mm longi, resinosi, minute argenteo-sericei, interdum in fructu glabri; *spicae* 10–25 mm longae, pallido aureum, floribus in spicos nec praecipue dense dispositis. *Flores* 5-meri; *calyce* minutus, longitudinale 1/5–1/4 corollae partes aequantia, 1/2–3/4 divisus irregulariter in lobis ± oblongis vel late triangularibus; *petala* 1.3–1.4 mm longa, glabra. *Legumina* sub-moniliformia, 20–60 mm longa, 2–3 mm lata, firme tenuiter crustacea, resinosa, minute argenteo sericea, obscure longitudinaliter nervata. *Semina* in legumine longitudinaliter ordinata, anguste ellipsoidea, 4–5 mm longa, 1.5–2 mm lata; *arillus* pusillus, albus.

Typus: Mount Channar Range, 24 km south-east of Paraburdoo, Western Australia, 6 August 2006, *E. Thoma* 1026 (*holo*: PERTH 07398409; *iso*: CANB, G, K, MEL, NSW).

Multi-stemmed, rounded or obconic *shrubs* (1.5–)2–3.5 m tall and 3–4 m across, crowns sparse to sub-dense, main stems and branches often sub-contorted. *Bark* grey, smooth but becoming rough and longitudinally fissured at base of mature stems. *Branchlets* terete, very finely (and obscurely) ribbed with silvery, appressed, straight hairs between the ribs at the extremities, soon glabrous. *New shoots* light green (the youngest phyllodes often brownish or tinged yellow but drying dark-coloured), resinous but not sticky. *Stipules* rudimentary, caducous, present only on very young new shoots. *Phyllodes* narrowly linear to very narrowly elliptic, 5–8(–10) cm long, 2–3(–4) mm wide, flat, coriaceous, sub-rigid, erect, straight to shallowly incurved, with short, straight, closely-appressed, silvery white hairs over the entire surface on uppermost phyllodes but indumentum becoming confined to between the nerves with age (the hairs difficult to see without magnification), sub-glaucous, dull green (with a slight bluish tinge) to silvery light greyish green; multistriate with numerous, very fine, slightly resinous *nerves* of uniform prominence; *apices* straight to curved or occasionally uncinate, narrowed to a small, blunt, brown callosity; *pulvinus* indistinct, 1–2 mm long, finely transversely wrinkled when dry. *Gland* minute and indistinct, situated on upper margin of phyllode 0–2 mm above the pulvinus. *Inflorescences* (few seen) simple, 1 or 2 within axil of phyllodes; *peduncles* 3–6 mm long, appressed silvery-white hairy with the hairs sometimes confined to lower half of peduncle and often obscured by resin, sometimes glabrous when in fruit; *spikes* 10–25 mm long, light golden, the flowers not especially densely arranged within the spikes (best observed in mature bud), the buds slightly resinous but not sticky; *receptacle* glabrous. *Bracteoles* sub-peltate, very small (about same length as calyx). *Flowers* 5-merous; *calyx* minute, 1/5–1/4 length of corolla, irregularly divided for 1/2–3/4 its length into ± oblong or broadly triangular, minutely and sparsely ciliolate lobes; *petals* 1.3–1.4 mm long, joined for 1/2–2/3 their length (the free portion recurved following dehiscence), glabrous, nerveless. *Pods* sub-moniliform (i.e. terete to sub-terete, gently raised over seeds and shallowly to moderately constricted between them), 20–60 mm long, 2–3 mm wide, thinly coriaceous-crustaceous, straight to very shallowly curved, resinous but not sticky, brown, minutely silvery sericeous between the obscure, longitudinal nerves; *marginal nerve* discrete (but not thickened) and yellowish. *Seeds* longitudinal in the pods, narrowly ellipsoid to narrowly obloid-ellipsoid, 4–5 mm long, 1.5–2 mm wide, shiny, dark brown; *pleurogram* commonly bordered by a diffuse band of dull yellow tissue; *areole* 'u-' or 'v-'shaped, open towards the hilum, very small (0.2–0.5 mm long); *funicle* folded beneath the small, white *aril*. (Figure 10)

Characteristic features. Multi-stemmed *shrubs*. *Branchlets* silver-sericeous towards extremities. *Phyllodes* narrowly linear to very narrowly elliptic, mostly 5–8 cm long and 2–3 mm wide, finely multistriate with nerves of uniform prominence, with silvery appressed hairs that become confined to between the nerves with age (hairs difficult to see without magnification and often obscured by resin). *Peduncles* short (3–6 mm long) and appressed-hairy; *spikes* golden with flowers not especially densely arranged. Flowers small (petals 1.3–1.4 mm long); calyx irregularly dissected for 1/2–3/4 its length, minute (1/5–1/4 length of corolla). *Pods* sub-moniliform (i.e. terete to sub-terete, gently raised over seeds and shallowly to moderately constricted between them), short and very narrow (20–60 × 2–3 mm), obscurely longitudinally nerved, minutely silvery sericeous between nerves. *Seeds* narrowly ellipsoid to narrowly obloid-ellipsoid, 4–5 mm long.

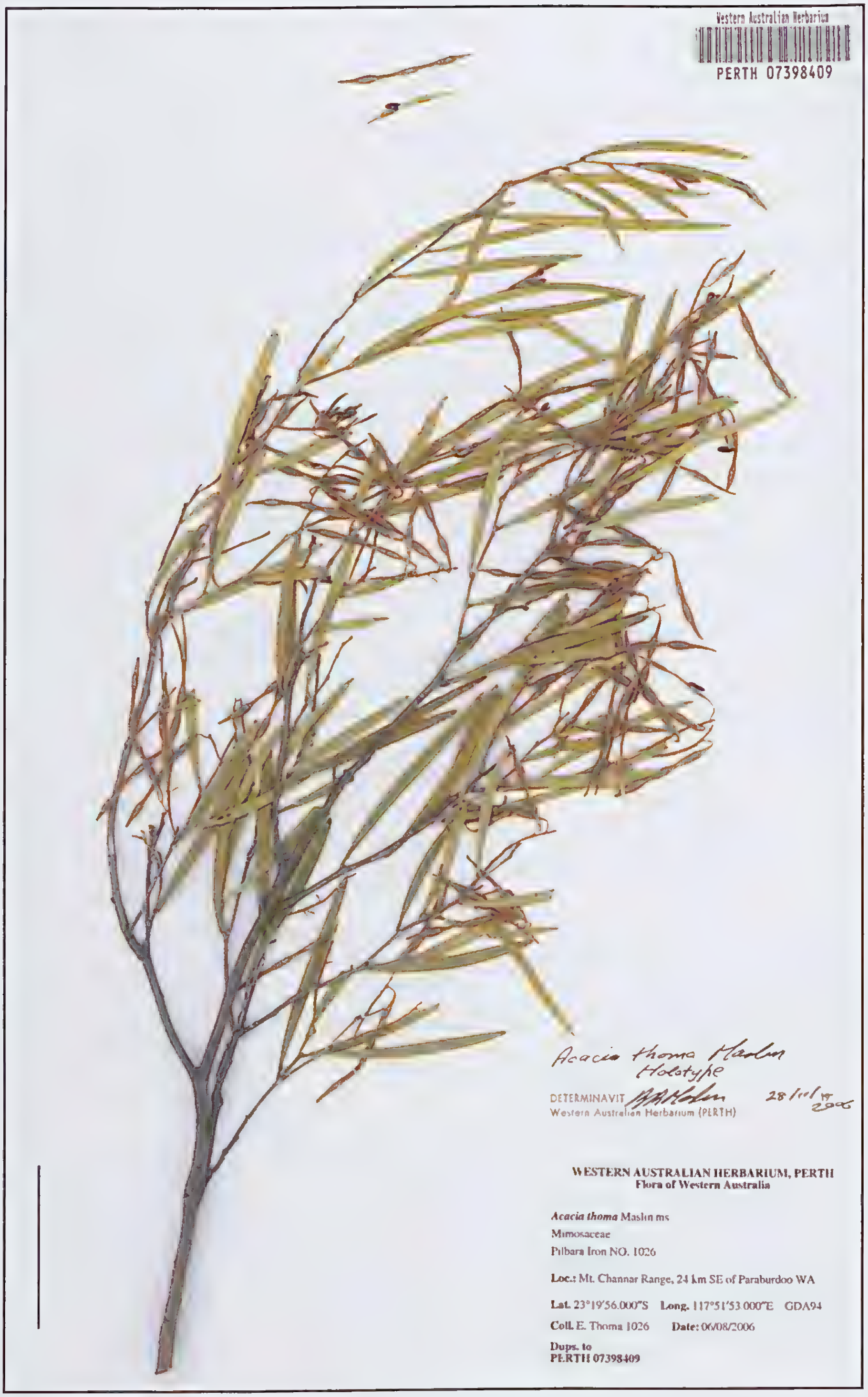

Western Australian Herbarium
PERTH 07398409
Acacia thoma Maslin
Holotype
DETERMINAVIT
Western Australian Herbarium (PERTH)
28/iii/2006
WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia
Acacia thoma Maslin ms
Mimosaceae
Pilbara Iron NO. 1026
Loc.: Mt. Channar Range, 24 km SE of Paraburdoo WA
Lat. 23°19'56.000"S Long. 117°51'53.000"E GDA94
Coll. E. Thoma 1026 Date: 06/08/2006
Dups. to
PERTH 07398409

Figure 10. Holotype of *Acacia thoma* Maslin (PERTH 07398409), scale = 5 cm.

Selected specimens examined. WESTERN AUSTRALIA: Leinster, 25 Aug. 1996, *G. Cockerton* 1542 (PERTH); Great Northern Highway, 12.3 km N of Meekatharra, 11 Oct. 2006, *R. Fairman* 257 (PERTH); Little Sandy Desert, Mt Nossiter, 125 km NE of Carnegie HS on Gunbarrel Highway to Warburton, 7 Sep. 1984, *B.R. Maslin* 5645 (NSW, PERTH); Mt Channar SE of Paraburdoo, 2 June 2006, *B.R. Maslin* 8781 (K, MEL, NSW, PERTH); 10 km NE of Leinster, adjacent to Leinster Nickel Operation gate house, May 2005, *P. Parkinson* LCS 12856 (AD, CANB, DNA, K, MEL, MO, NSW); Mt Channar, 22 Oct. 2005, *E. Thoma* 857 (PERTH); Mt Channar area, 9 Sep. 1984, *P.A.S. Wurm* 1522 (PERTH).

Distribution and ecology. Occurs in Western Australia where it has a scattered distribution from the Pilbara region south to Meekatharra and Leinster and extending east to Mt Nossiter in the Little Sandy Desert (*A. subcontorta* shows a somewhat similar distribution pattern, see above). In the Pilbara *A. thoma* is confined to the Mt Channar region (Eastern Range), east of Paraburdoo where it occurs in two areas (about 15 km apart), both of which contain a few small, discontinuous populations that extend over a distance of about 1 km. It is likely that further collecting throughout the range of this species will show it to be more common than current knowledge indicates; *A. thoma* is rather difficult to identify in the absence of pods. In the Pilbara *A. thoma* grows in skeletal soil on ridges and rocky slopes towards the base of banded ironstone hills, in open shrubland with common associates including *Acacia aneura, A. sibirica, A. rhodophloia, A. tetragonophylla, Eremophila jucunda* and *E. fraseri*. At its more southerly localities *A. thoma* is also normally associated with rocky habitats, for example, at Leinster it is reported to occur in soil over ironstone, ultramafic rocks in association with Mulga shrublands (see *G. Cockerton* 1542), while at Mt Nossiter it is reported to grow in a 'rocky habitat' but the rock type was not identified (see *B.R. Maslin* 5645). The Meekatharra collection (*R. Fairman* 257) was gathered from a road verge situation in 'dry red soil', and the underlying rock type was not identified.

Flowering and fruiting period. This species appears to flower in response to summer rainfall events. Plants in flower have been collected in May and June and pods with mature seed have been collected from August to October.

Conservation status. Not considered rare or endangered. However, it is noted that the species is currently not known to be represented on the Western Australian conservation estate.

Etymology. This species is named for Emil Thoma, Botanical Advisor with Pilbara Iron. Emil has worked in the Pilbara region for 30 years during which time he has provided the authors with much assistance (particularly in the form of specimens and information) concerning the *Acacia* flora of that region. Apart from *Acacia* Emil has been instrumental in documenting the distribution of numerous Declared Rare and Priority Flora species in the Pilbara region, has recorded many new plant records for the region and has collected several novel taxa including *Ptilotus subspinescens*. The epithet 'thoma' is used here deliberately as a noun in apposition, thus requiring no change by the addition of a case ending.

Common name. Thoma's Wattle (suggested new common name).

Affinities. *Acacia thoma* belongs to *Acacia* sect. *Juliflorae* and appears to be most closely related to the more southerly distributed *A. effusifolia* Maslin & Buscumb (syn. *A. coolgardiensis* Maiden subsp. *effusa* R.S.Cowan & Maslin); indeed, Cowan and Maslin (1995: 22) treated the Pilbara occurrence of *A. thoma* as a northern outlier of subsp. *effusa*. *Acacia effusifolia* comprises two informal variants which are distinguished on the basis of their peduncle length and it is the variant with pedunculate spikes that most closely resembles *A. thoma* but which is most readily distinguished in the following ways: main stems fluted with at least some vertical furrows and folds (stems not fluted in *A. thoma*), peduncles invested with red-brown resin hairs additional to the silvery-white appressed orthodox hairs (resin hairs not present in *A. thoma*), flowers larger (petals about 1.8 mm long) and more densely arranged in the spikes, calyx much longer (1/2 –2/3 length of corolla) with the sepals normally free (or sometimes shortly united at the base), pods not or scarcely constricted between the seeds and seeds slightly shorter (3–4 mm long) and differently shaped (i.e. obloid). Additionally, there are subtle differences in the phyllode nerves (broader in *A. effusifolia* than in *A. thoma*) which suggests underlying anatomical differences between the two. Although there is overlap in the range of variation for phyllode size between the two taxa, *A. effusifolia* often has longer phyllodes (to 14 cm long).

In the Pilbara region *A. thoma* is most similar to *A. sibirica* S.Moore (syn. *A. stowardii* Maiden) as the two species are often similar in habit and phyllode shape and size, and both have pedunculate spicate inflorescences. *Acacia thoma* and *A. sibirica* are sometimes sympatric and special care is needed not to confuse them, at least when pods are not present on the plants. Fruiting specimens are easy to distinguish because *A. sibirica* has narrowly oblong, flat pods which are 3–5(–7) mm wide, whereas those of *A. thoma* are sub-moniliform, ± terete and narrower (2–3 mm wide). Indumentum is another character that enables these two species to be distinguished; in *A. sibirica* the branchlets, phyllodes and peduncles are glabrous whereas in *A. thoma* these structures are invested with silvery-white appressed hairs (see above description). However, the hairs in *A. thoma* are not especially obvious and specimens must be carefully examined at ×10 magnification or above to see them. The calyx of *A. sibirica* is also different from that of *A. thoma* in being longer, broader at its base and less deeply dissected into broadly triangular lobes. Some flat-phyllode forms of Mulga (*A. aneura* F.Muell. ex Benth.) may also superficially resemble the new species (and may grow sympatrically with it) but are readily distinguished by their broader, flat pods and linear, free sepals; also, the phyllode nerves of these Mulgas are resinous and normally more obvious than those of *A. thoma*.

Acacia trudgeniana Maslin, *sp. nov.*

Frutex (0.5–)2–5 m altus, caulis principalibus 1 vel 2 strictis vel fractuosis instructis; *ramulis* lateralibus breves et patuli. *Cortex* suberosus, crassus. *Ramuli* glabri, non pruinosi. *Stipulae* spinosae sed frequente tantum bases in vetuste persistentibus. *Phyllodia* (15–)30–50 mm longa, (8–)15–30(–37 mm lata, inaequilater ovata vel elliptica aut raro obovata, coriacea, undulata, distincte sub-glauca (sed non pruinosa), demum obscure viridia, costa ad marginem inferiore posita, nervis minoribus reticulum compactum fasciens; *apices* brevi-acuminati et cuspidati. *Inflorescentiae* racemosae; *axes racemi* 3–15 cm longi, glabri, obscure purpureo rubri; *pedunculi* plerumque volubiles, glabri, obscure purpureo rubri; *capitula* globularia; *flores* 20–25, pallido aurei. *Bracteoli* absentes. *Flores* 5-meri; *gemmis* obscure purpureo rubri; *sepala* libra vel sub-libra, linearia vel anguste oblonga; *petala* enerves. *Legumina* et semina non vidi.

Typus: about 27 km due east of Newman, 14 km east of Newman–Marble Bar road on Shovelanna Road, then 2.3 km along Jimblebar Road on north side of railway, 23° 20' 32" S, 120° 00' 28" E, Western Australia, 12 October 2004, *B.R. Maslin* 8686 (*holo*: PERTH 06927750; *iso*: CANB, K, MEL).

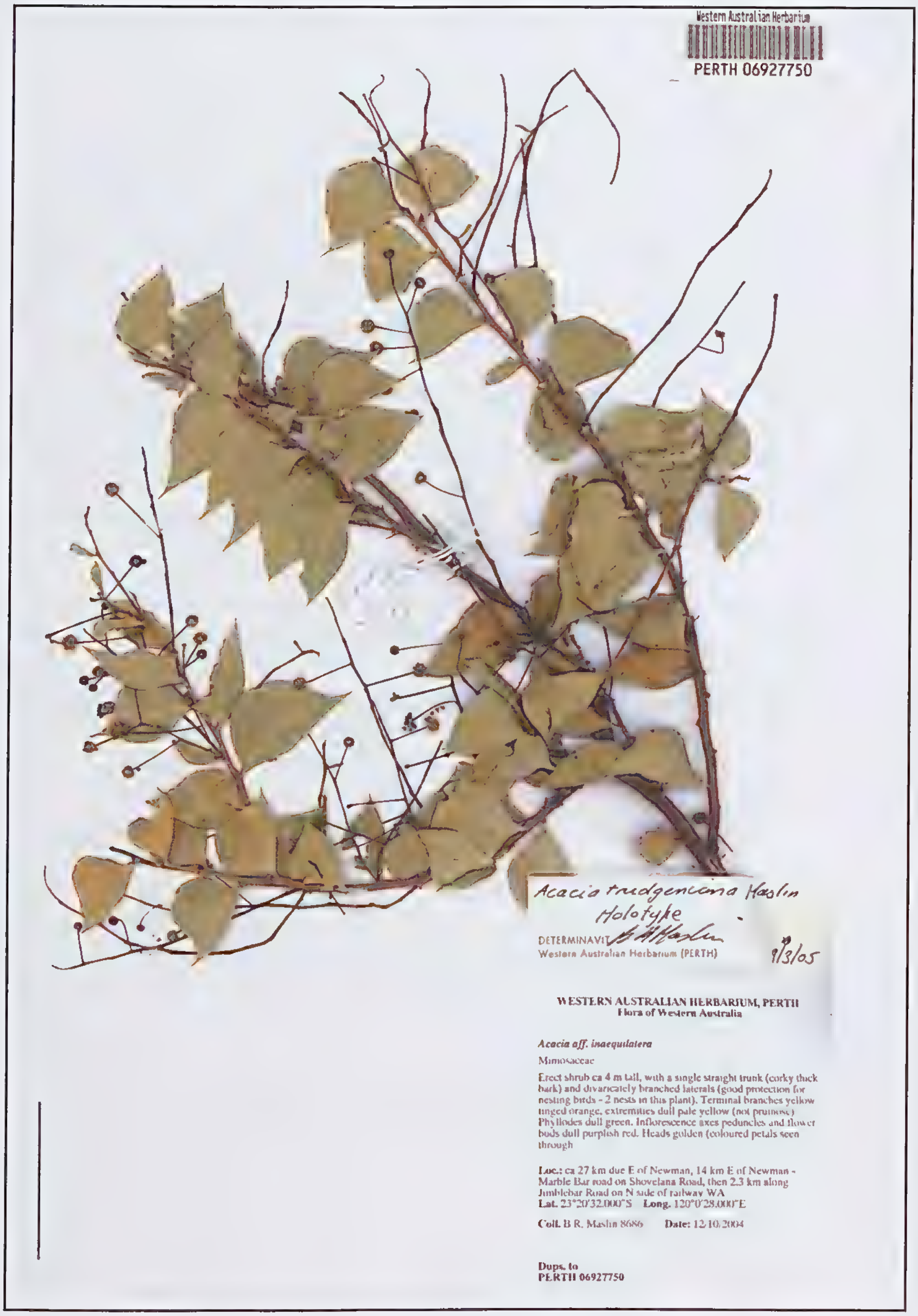
Acacia sp. Mount Hilditch (M.E. Trudgen 19134), in Council of Heads of Australasian Herbaria, *Australian Plant Census*, http://www.anbg.gov.au/chah/apc/index.html [accessed 19 February 2008].

Erect *shrubs* (0.5–)2–5 m tall, with 1 or 2, straight or crooked main stems from ground level (plants appearing ± gnarled when stems crooked), the lateral branches short and wide-spreading. *Bark* corky, thick, longitudinally furrowed, light grey (but surface often blacked by fire) except dull pale yellow in furrows. *Branchlets* terete, finely ribbed, glabrous, light brown to dull yellow tinged orange (often dull pale green at extremities), not pruinose. *New shoots* light green. *Stipules* spiny but often only the bases persisting (as blunt knob-like protuberances) with age, 4–8 mm long, patent, straight, brown, rigid. *Phyllodes* inaequilaterally ovate to elliptic or rarely obovate, upper margin prominently rounded and much longer than the shallowly convex to shallowly sigmoid lower margin, (15–)30–50 mm long, (8–)15–30(–37) mm wide, coriaceous, undulate, distinctly sub-glaucous (but not pruinose), ageing dull green; *midrib* evident (but not raised), excentric (near lower margin), yellow (when dry); the *minor nerves* forming a close reticulum; *apices* short-acuminate and ending in a short, straight, rigid, brown, spiny, excentric cusp 1–3 mm long. *Gland* situated on upper margin of phyllode at distal end of pulvinus, 1–2 mm long, not raised. *Inflorescences* (few seen) elongated racemes that extend beyond the phyllodes, 1 or sometimes 2 per axil; *raceme axes* 3–15 cm long, dull purplish red, glabrous; *peduncles* 7–20(–25) mm long, twinned (rarely 3) and often with a phyllode within their angle (these phyllodes are initiated as small, bract-like structures), glabrous, dull purplish red; *heads* globular, light golden, 20–25-flowered, (the purplish red petals may be seen between the exerted anthers). *Bracteoles* absent. *Flowers* 5-merous, glabrous, dull purplish red when in bud; *sepals* slightly less than 1/2 length of petals, free or almost so, linear to narrowly oblong; *petals* 2 mm long, nerveless, glabrous. *Pods* and *seeds* not seen. (Figure 11)

Characteristic features. Erect *shrubs* (0.5–)2–5 m tall, with 1 or 2, straight or crooked main stems and short, wide-spreading lateral branches, plants appearing ± gnarled when main stems crooked. *Bark* thick and corky. Branchlets not pruinose. *Stipules* spiny but often only the bases persisting with age. *Phyllodes* very asymmetric with midrib situated near lower margin, minor veins forming a net-like reticulum, coriaceous, undulate, sub-glaucous (but not pruinose) ageing dull green, terminated by a needle-sharp tip. *Inflorescences* long-racemose (3–15 cm long); *raceme axes, peduncles* and *flower* buds dull purplish red; *heads* 20–25-flowered. *Sepals* free. *Flowering* commencing in September/October.

Other specimens examined. WESTERN AUSTRALIA: N of Winning Pool, 11 Oct. 1941, *C.A.Gardner* 6232 (PERTH); about 35 km due E of Newman, 15.5 km E of Newman–Marble Bar road on Shovelanna Hill Road (parallel to Jimblebar Road on N side of railway line), 31 May 2004, *B.R. Maslin* 8520 (PERTH); Ethel Creek Station (NNE of Newman), 31 May 2004, *B.R. Maslin* 8525 (PERTH); Balfour Downs Station, 1 June 2004, *B.R. Maslin* 8541 (PERTH); about 1 km due E of The Governor, Hamersley Range, 3 June 2004, *B.R. Maslin* 8559 (PERTH); Yanrey Station (S of Onslow), 6 Oct. 2004, *B.R. Maslin* 8636A (NSW, NT, PERTH); Barrow Island, 27 July 2006, *B.R. Maslin* 8800 (PERTH); Balfour Downs Station, 12 Aug. 2006, *B.R. Maslin* 8856 (PERTH); Mt Meharry, 14 Oct. 1983, *P. Ryan s.n.* (PERTH 00165328); near Ranger's Residence, Hamersley Range National Park, 26 Sep. 1980, *E. & I. Solomon* 9 (PERTH); 4.3 km NW of Mt Montagu, 8 Apr. 1997, *M.E. Trudgen* MET 15011 (PERTH); 2.5 km N of The Governor, Hamersley Range, 23 Sep. 1997, *M.E. Trudgen* MET 18366 (PERTH); 5.2 km SSE of Mt Montagu, 16 May 1997, *M.E. Trudgen* MET 19134 (PERTH); 20.3 km SW of Mt Bruce, Karijini National Park, 6 Aug.1998, *S. van Leeuwen* 3627 (PERTH); 0.6 km SSW of Packsaddle Hill, Hamersley Range, 22 Sep. 1997, *A. Weston* 20196 (PERTH).

Distribution and ecology. Of scattered occurrence in north-west Western Australia where it extends from Winning and Yanrey Stations located inland from Exmouth Gulf, north-east through the Hamersley Range to Balfour Downs Station in the eastern Pilbara region; it also occurs north of the Hamersley Range near Mt Montagu in the Millstream-Chichester National Park, from the Yule



Acacia trudgeniana Maslin
Holotype
DETERMINAVIT B R Maslin 9/3/05
Western Australian Herbarium (PERTH)

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Acacia aff. inaequilatera

Mimosaceae

Erect shrub ca 4 m tall, with a single straight trunk (corky thick bark) and divaricately branched laterals (good protection for nesting birds - 2 nests in this plant). Terminal branches yellow tinged orange, extremities dull pale yellow (not pruinose) Phyllodes dull green. Inflorescence axes peduncles and flower buds dull purplish red. Heads golden (coloured petals seen through

Loc.: ca 27 km due E of Newman, 14 km E of Newman - Marble Bar road on Shovelana Road, then 2.3 km along Jimblebar Road on N side of railway WA
Lat. 23°20'32.000"S **Long.** 120°0'28.000"E

Coll. B R. Maslin 8686 **Date:** 12/10/2004

Dups. to
PERTH 06927750

Figure 11. Holotype of *Acacia trudgeniana* Maslin (PERTH 06927750), scale = 5 cm.

River crossing on North West Coastal Highway south of Port Hedland, and from Barrow Island off the Pilbara coast. A sterile specimen (*K. McCreery* GIR 01-03, PERTH) from Giralia Station at the bottom of Exmouth Gulf may be this species, however, more complete material is needed to check its identification. Commonly forms small, localized populations in the places where it occurs. Grows on red sand or brown loam with a mantle of ironstone pebbles over 'Spinifex' ground cover, on flat or low-undulating plains.

Flowering and fruiting period. Flowering commences between early September and early October but because of the paucity of specimens it is not known when it ceases (perhaps around December). Pods have not been seen.

Conservation status. Not considered rare or endangered. Recorded from Barrow Island Nature Reserve and represented in the Millstream–Chichester and Karijini National Parks.

Etymology. This new species is named for Malcolm Trudgen, botanist, who has a particular interest in the Pilbara and the family Myrtaceae. Over the past 30 years Malcolm has collected extensively in the Pilbara during the course of his many vegetation and flora surveys of that area (e.g. Trudgen & Casson 1998; Trudgen 2002). It was Malcolm who first drew our attention to the existence of this new species, although he was not the first to collect it.

Common name. Trudgen's Wattle (suggested new common name).

Affinities. Acacia trudgeniana is a member of *Acacia* sect. *Acacia* and is most closely related to *A. inaeqilatera* Domin and can be easily confused with this species on account of its thick corky bark, spiny stipules, coriaceous, reticulately-veined, spine-tipped phyllodes which are markedly asymmetric (midrib near lower margin), brightly coloured, long racemes, peduncles and petals, and its free sepals. However, *A. inaeqilatera* is most readily distinguished by its pruinose branchlets, pruinose, often more blue-grey phyllodes, slightly more flowers per head (30–40), earlier flowering period (May–August) and its generally more gnarled, diffuse growth form. The two species grow in close proximity in some places but are not known to be sympatric. *Acacia inaeqilatera* is far more common in the Pilbara than *A. trudgeniana*. *Acacia marramamba* Maslin is also related to *A. trudgeniana* but is distinguished by having a more straggly growth form, non-corky bark, sparingly and openly anastomosing minor nerves on the phyllodes and brownish red raceme axes, peduncles and flower buds. These three species along with *A. pyrifolia* DC. and *A. strongylophylla* F.Muell. (which does not occur in the Pilbara) comprise the informal '*A pyrifolia* group'.

Variation. A dwarf form of this species, 0.5 m tall, occurs at one locality on Barrow Island; the phyllodes on this entity are smaller than normal (15–25 mm long, 8–10 mm wide). A superficially similar small phyllode form occurs on Legendre Island in the Dampier Archipelago (*R.D. Royce* 7287 PERTH) but habit details are unknown for this plant. On the mainland, plants with smallest phyllodes are found on a few specimens from West Angelas (25–35 mm long and 10–20 mm wide).

Notes. A fire-tolerant species with its thick protective bark and its ability to resprout by epicormic growth following burns. Also has the capacity to resprout after the above ground biomass has been removed through bulldozing and other clearing operations. One plant of *A. trudgeniana* has been observed to emit a delicate, faint honey odour (?from flowers) in the heat of the afternoon. This species provides good wildlife protection and bird nests have been observed in a number of plants.

Acacia walkeri Maslin, *sp. nov.*

Frutex debilis glaber (1–)2–2.5(–3.5) m altus. *Ramuli* pallido brunnei vel rubri, resinosi, plerumque viscidi, lenticellulosi. *Stipulae* persistentes, minutae, erectae, in resina inclusae. *Phyllodia* acicularia, quadrangularia vel plana, (8–)10–20(–30) mm longa, 0.5–1.2 mm lata, rigida, recta, plerumque subglauca vel ± glauca, infrequenter pallido viridia, semper 4-nervata, costa ± prominens ubi phyllodia plana; ad *apicem* versus cuspidem acutam strictam leniter attenuata. *Inflorescentiae* simplices; *pedunculi* 10–15(–20) mm longi, graciles; *capitula* globularia, in statu vivo 5–6 mm diam. *Flores* 5-meri; *sepala* libra, lineari-spathulata. *Legumina* sub-moniliformia, (20–)30–50 mm longa, 3 mm lata, firme vel tenuiter coriacea. *Semina* atrobrunnea vel nigella et marmorato cremea; *funiculus* filiformis, nec in arillo expansus.

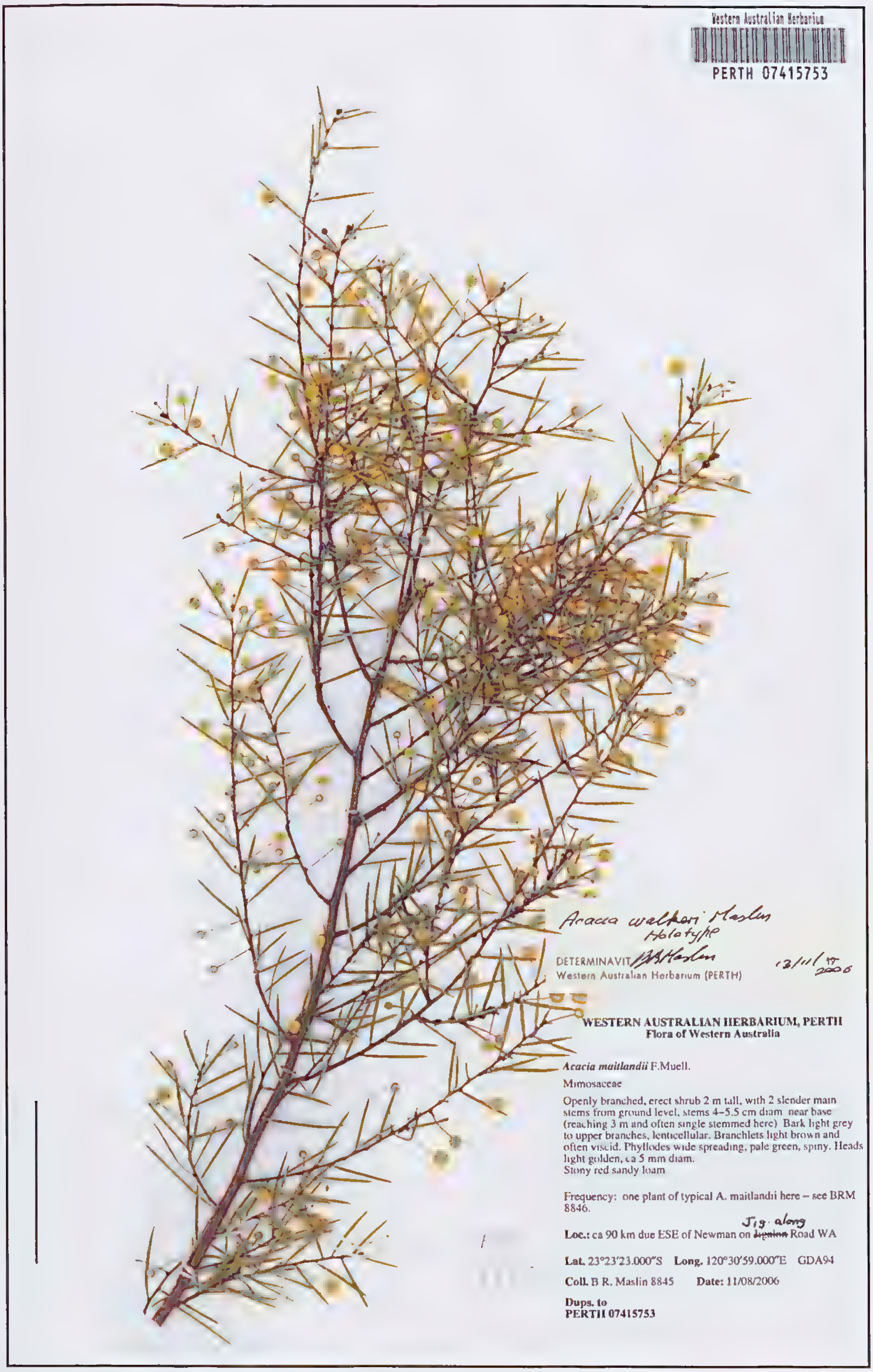
Typus: About 90 km due east-south-east of Newman on Jigalong road, 23° 23' 23" S, 120° 30' 59" east, Western Australia, 11 August 2006, *B.R. Maslin* 8845 (*holo*: PERTH 07415753; *iso*: CANB, K, MEL, NT).

Acacia maitlandii aciculiform variant *sensu* Maslin, in J. Jessup, *Fl. Central Australia* p. 129 (1981) and *Fl. Australia* 11A p. 388 (2001).

Acacia sp. Gunbarrel (B.R. Maslin 5665), in Council of Heads of Australasian Herbaria, *Australian Plant Census*, http://www.anbg.gov.au/chah/apc/index.html [accessed 19 February 2008].

Spindly and sometimes straggly, erect, glabrous *shrubs* (1–)2–2.5(–3.5) m high, with 1 or 2 slender stems from ground level, stems 4–5.5 cm diameter near base, typically openly branched with sparse foliage but sometimes bushy, phyllodes occasionally crowded at ends of branches. *Bark* light grey, smooth. *Branchlets* light brown to red, resinous, often viscid, lenticellate, scarred where phyllodes have fallen. *Stipules* persistent, triangular, minute (0.5–1 mm long), erect, brown, often enveloped by resin. *Phyllodes* acicular, linear, quadrangular-terete to flat, (8–)10–20(–30) mm long, 0.5–1.2 mm wide, with l:w=30, rigid, patent to slightly inclined, straight, normally sub-glaucous to ± glaucous, infrequently pale green, not pruinose, 4-nerved (one on each face and one on each margin when flat), midrib ± prominent and raised on flat phyllodes when dry; gradually narrowed at *apices* into a very sharp, rigid, straight, brown cusp *c.* 1 mm long. *Inflorescences* simple, single or 2 within axil of phyllodes; *peduncles* straight, slender, spreading, rarely exceeding the phyllodes, yellow (often light brown when dry), 10–15(–20) mm long, basal peduncular bracts absent; *heads* showy, globular, 5–6 mm in diameter when fresh, light golden to mid-golden, with 40–60 flowers. *Flowers* 5-merous; *sepals* free, linear-spathulate, *c.* 3/4 length of petals; *petals* 1.6 mm long. *Pods* sub-moniliform, rounded over seeds and constricted between them, (20–)30–50 mm long, 3 mm wide, firmly chartaceous to thinly coriaceous, straight or almost so, reticulately nerved but nerves not or scarcely evident, light brown. *Seeds* longitudinal in the pods, obloid to obloid-ellipsoid, 3–3.5 mm long, 2–2.5 mm wide, dull, dark brown to blackish and mottled cream, with cream-coloured tissue bordering the *pleurogram* and bordering the periphery of the seed; *funicle* thread-like and not expanded into an *aril*. (Figure 12)

Characteristic features. Erect, spindly, glabrous *shrubs* with 1 or 2 slender stems from ground level. *Branchlets* light brown to red, resinous, often viscid, lenticellate. *Stipules* persistent, minute, erect, often embedded in resin. *Phyllodes* acicular, mostly 10–20 mm long, very narrow (0.5–1.2 mm wide), rigid, straight, normally sub-glaucous to ± glaucous, infrequently pale green, quadrangular-terete to flat, 4-nerved, midrib ± prominent when phyllodes flat; *apices* gradually narrowed to a very sharp, straight cusp. *Inflorescences* simple; *peduncles* straight, slender, spreading, rarely exceeding the phyllodes,



Western Australian Herbarium
PERTH 07415753

Acacia walkeri Maslin
Holotype

DETERMINAVIT B.R. Maslin 13/11/2006
Western Australian Herbarium (PERTH)

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Acacia maitlandii F.Muell.

Mimosaceae

Openly branched, erect shrub 2 m tall, with 2 slender main stems from ground level, stems 4–5.5 cm diam near base (reaching 3 m and often single stemmed here) Bark light grey to upper branches, lenticellular. Branchlets light brown and often viscid. Phyllodes wide spreading, pale green, spiny. Heads light golden, ca 5 mm diam.
Stony red sandy loam

Frequency: one plant of typical A. maitlandii here – see BRM 8846.

Loc.: ca 90 km due ESE of Newman on ~~Jigalong~~ Jig. along Road WA

Lat. 23°23′23.000″S **Long.** 120°30′59.000″E GDA94

Coll. B R. Maslin 8845 **Date:** 11/08/2006

Dups. to
PERTH 07415753

Figure 12. Holotype of *Acacia walkeri* Maslin (PERTH 07415753), scale = 5 cm.

yellow (often light brown when dry), 10–15(–20) mm long; *heads* globular, 5–6 mm in diameter when fresh. Sepals free, linear-spathulate. *Pods* sub-moniliform, 3 mm wide, narrow, thin-textured. *Seeds* dark brown to blackish and mottled cream; *funicle* thread-like and not expanded into an aril.

Selected specimens examined. WESTERN AUSTRIALIA: Great Victoria Desert, 338 km by road NE of Laverton, Warburton road, 17 Sep. 1978, *A.C. Beauglehole & E.G. Errey* ACB 60073 (PERTH); road west of Rawlinson Range, 25 June 1960, *J.B. Cleland s.n* (PERTH 00113778).; 52 km W of Warburton Mission, 18 Nov. 1978, *H. Demarz* D7228 (PERTH); on track towards Carnarvon Range, 35 km from Old Mary Mia, on N edge of Miss Fairbairn Hills, in proposed Carnarvon Range Conservation Park, SW edge of Little Sandy Desert, 23 Aug. 1999, *D.J. Edinger* Nats 2 (PERTH); 10 miles [16 km] E of Todd Range, Gunbarrel Highway, 1 Oct. 1966, *A.S. George* 8199 (PERTH); Rawlinson Range, *c.* 32 miles [51 km] W of Giles, 3 Oct. 1966, *A.S. George* 8268 (PERTH); entrance to Glen Cumming, Rawlinson Range, 21 July 1967, *A.S. George* 8850 (AD, NSW, PERTH); Giles Settlement, in Rawlinson Range, *c.* 70 km west of Northern Territory border, 29 July 1964, *R. Hill* 1384 (PERTH ex AD); Gibson Desert, 13 km E of Todd Range along Gunbarrel Highway, 12 June 1983, *S.D. Hopper* 2826 (PERTH); 4 km E [of] Lake Christopher, Rawlinson Range, 23 July 2001, *P.K. Latz & G.J. Morse* 17959 (PERTH ex NT); 52 miles [83 km] W of Giles, 21 Sep. 1969, *J.R. Maconochie* 810 (PERTH ex NT); Gibson Desert, 140.5 km by road SE of Mt Everard on 'Heather Highway' which intersects Gunbarrel Highway just SE of Lake Breaden, 9 Sep. 1984, *B.R. Maslin* 5661 (CANB, K, PERTH, distributed as *A. maitlandii*); Keartland district, Savoury Creek, 8 June 1984, *G.J. Morse* 82 (PERTH ex CANB).

Distribution and ecology. Confined to the Western Australian arid zone where it extends from the western edge of the Little Sandy Desert and Pilbara regions eastwards through the northern Great Victoria Desert and southern Gibson Desert to the Central Ranges near the border of Northern Territory and South Australia. *Acacia walkeri* is rare in the Pilbara where it is known from just a single, large population about 90 km east-south-east of Newman (the type population). It is recorded from red sand plains and rocky slopes in gravel and lateritic soils (sandy loam or clayey sand), with other shrubs and 'Spinifex'.

Flowering and fruiting period. Flowering has been recorded from June to October with peak flowering in August and September. Pods with mature seeds have been collected in October and November.

Conservation status. Not considered rare or endangered. However, it is noted that the species is not known from the Western Australian conservation estate.

Etymology. This new species is named for Mr Ken Walker who has collected many plants (over 600) from the Pilbara during the past 30 years. Ken made the first ever collection of *A. subcontorta* Maslin (see above) and has undertaken many specific collections of Pilbara acacias on our behalf. Ken was a founding contributor to the (now disbanded) Pilbara Regional Herbarium and has been instrumental in improving standards of landform and vegetation rehabilitation, and weed control on mine sites, throughout the region.

Common name. Walker's Wattle (suggested new common name).

Affinities. Acacia walkeri is a member of *Acacia* sect. *Acacia* and is very closely related to *A. maitlandii* F.Muell.; indeed, the new taxon was noted as a narrow phyllode variant of *A. maitlandii* by Maslin (1981: 129, 2001: 388). The two species sometimes grow together (e.g. in the Pilbara region a single plant of *A. maitlandii*, *B.R. Maslin* 8846, was found in the large population of *A. walkeri* from which the type was collected) but hybrids are not known to occur. *Acacia maitlandii* can be distinguished from *A. walkeri* in having broader phyllodes, (1.5–)2–4(–5) mm wide, which are differently shaped (± asymmetrically narrowly elliptic to oblong-elliptic or oblong-obovate) and consistently flat and green, larger flower heads (*c.* 9 mm in diameter when fresh) and normally broader pods that measure (3–)4–5(–10) mm wide. Future studies may show that *A. walkeri* would be better treated as a subspecies of *A. maitlandii*. *Acacia walkeri* could possibly be confused with *A. tetragonophylla* F.Muell. ex Benth. if only new shoots are present on the latter. At mature nodes in *A. tetragonophylla* the phyllodes are clustered in groups of 2–6 but on new shoots the phyllodes occur singly at the nodes as they do in *A. walkeri*. In cases where only new shoots of *A. tetragonophylla* are present that species can be recognised by its 5-nerved phyllodes (4-nerved in *A. walkeri*), caducous stipules and non-lenticellate branchlets; *A. tetragonophylla* also has much larger, curved to coiled pods with the seeds encircled by a bright orange-red or yellow aril.

Acknowledgements

This research was generously supported by Robe River Mining with funds provided under the auspices of the West Angelas Coondewanna West Environmental Offsets Agreement. Emil Thoma (Pilbara Iron) is thanked for providing specimens, information and photographs of a number of the species described here. Similarly, Ken Walker and Malcolm Trudgen are thanked for providing specimens and information for some of the species. Paul Udinga, Maitland Parker, Craig Faulkner, Tony Coyle, Portia Brown and other DEC staff at Karijini and Millstream–Chichester National Parks and in Karratha are thanked for providing accommodation and other assistance while conducting field surveys in the Pilbara. We are most appreciative of the field assistance and good company provided by DEC volunteers Daphne Edinger and Gilbert Marsh, during two of the Pilbara field trips. Paul Parkinson (Environmental Officer, BHP Billiton–Nickel West) and Gemma O'Keefe (Landcare Holdings Pty Ltd) are thanked for facilitating a visit by the first author to inspect the *A. thoma* site at Leinster in 2006. Bob Bromilow, Jordan Reid and Richard Fairman are thanked for providing valuable technical assistance, and Meriel Falconer for carefully checking our specimen citations against the collection at the Western Australian Herbarium. Paul Wilson is thanked for providing the Latin descriptions.

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An updated diagnosis for *Eucalyptus* series *Accedentes* (Myrtaceae) and a new mallee species for the series occurring in far western Australia

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Abstract

Nicolle, D. & Brooker, M.I.H. An updated diagnosis for *Eucalyptus* series *Accedentes* (Myrtaceae) and a new mallee species for the series occurring in far western Australia. *Nuytsia* 18: 189–196 (2008). *Eucalyptus* L'Hér. ser. *Accedentes* Chippend. is diagnosed by an exclusive combination of characters for the first time. The series consists of nine species, all but one of which are endemic to Western Australia, including the newly described *Eucalyptus baiophylla* D.Nicolle & Brooker, a mallee occurring between Exmouth and Carnarvon on the west coast of Australia. The new species was formerly included in *E. prominens* Brooker and is most closely related to *E. zopherophloia* Brooker & Hopper. A key to the series is included and a map and illustrations of the new species are provided.

Introduction

We here recognize nine species within *Eucalyptus* L.'Hér. ser. *Accedentes* Chippend., viz. *E. accedens* W.Fitzg., *E. laeliae* Podger & Chippend., *E. leprophloia* Brooker & Hopper, *E. pilbarensis* Brooker & Edgecombe, *E. prominens* Brooker, *E. pruiniramis* L.A.S.Johnson & K.D.Hill, *E. trivalva* Blakely, *E. zopherophloia* Brooker & Hopper and the new species *E. baiophylla* D.Nicolle & Brooker *sp. nov.* Of these taxa, the well-known powderbark wandoo, *E. accedens*, was the first to be published and also represents the type species of the series. *Eucalyptus accedens* occurs on the higher parts of the Darling Range of southern Western Australia and is one of two notably smooth-barked eucalypt tree species widespread in the Range. The other species is the more widespread *E. wandoo* Blakely of *E.* ser. *Levispermae* Maiden. The two species are not closely related, although they share the common name wandoo.

The natural affinity of *E. accedens* was not recognised by early botanists. Maiden (1920) suggested an affinity with *E. redunca* Schauer (the name generally then attributed to *E. wandoo*), with *E. foecunda* Schauer (*E.* ser. *Porantherae* Benth.) and with *E. incrassata* Labill. (*E.* sect. *Dumaria* L.D.Pryor & L.A.S.Johnson ex Brooker). These three species are not closely related to *E. accedens* and belong to unrelated taxonomic series.

Blakely (1934) was clearly uncertain of the taxonomic position of *E. accedens* and placed it in the large *E.* ser. *Dumosae* Blakely, which comprised a considerable mixture of species recognised later to belong to several other series. *Eucalyptus* ser. *Dumosae* is typified by *E. dumosa* A.Cunn. ex Oxley and is characterised, among other characters, by reniform cotyledons compared to the bisected cotyledons of *E. accedens* and of two of the three species mentioned above.

Podger and Chippendale (1969), in publishing *E. laeliae*, stated that its natural affinity was with *E. accedens* with which it had been previously confused. Both species are smooth-barked trees, but the former has a more restricted distribution on the higher parts and western side of the central and southern Darling Range, including Mt Cooke, the highest point in the range.

Pryor and Johnson (1971) published their comprehensive but informal classification of the genus *Eucalyptus*, where they informally erected *E.* ser. *Accedentes* to accommodate *E. accedens, E. laeliae* and *E. trivalva*, the last-named species having also been incorrectly placed by Blakely (1934) in series *Dumosae*. Pryor and Johnson (1971) gave no diagnoses for their newly erected series.

Eucalyptus prominens occurs on Cape Range, west of Exmouth Gulf. Brooker (1976) provided no discussion of affinities apart from stating that the new species was related to *E. trivalva*. The species newly described here, which has long been included in *E. prominens*, was first collected in the 1970s south of Exmouth Gulf.

Eucalyptus pilbarensis is a mallee from the higher parts of the Pilbara region of central northern Western Australia. Brooker and Edgecombe (1986: 377, 380) stated that 'the simple axillary infloresences bi-operculate buds, oblong anthers, bisected cotyledons, glandular pith, non-waxy, straight-sided fruit, and elliptical to ovate seed with a shallow reticulum place *E. pilbarensis* in *E.* subgenus *Symphyomyrtus* sect. *Bisectaria* series *Accedentes* of the informal classification of Pryor and Johnson (1971).' This account was the first description of the series, but lacked comparisons with related taxa.

Chippendale (1988) published the *Flora of Australia* treatment of the genus *Eucalyptus*. This was the first formal comprehensive statement on the taxonomy of the genus since Blakely (1934). In this work Chippendale erected *E.* ser. *Accedentes* without acknowledgement of the informal publication of the name by Pryor and Johnson (1971). The publication was formalised by a description in Latin only (Chippendale 1988, p. 495), with the English description of *E.* ser. *Accedentes* provided elsewhere in Chippendale's treatment of *Eucalyptus* (Chippendale 1988, p. 230). Both the Latin and English descriptions of the series provided by Chippendale (1988) did not include reference to related series nor provide an exclusive combination of characters for *E.* ser. *Accedentes*.

Eucalyptus pruiniramis is a poorly formed tree or mallee of very restricted distribution from Arrino and Mogumber north of Perth. It has some rough bark, white waxy branchlets, and large buds and fruits, which distinguish it from *E. accedens*. Hill and Johnson (1992) placed the species in *E.* ser. *Accedentes,* which was given a minimal diagnosis. The following year Brooker and Hopper (1993) described *E. lеprophloia* and *E. zopherophloia* and placed both in *E.* ser. *Accedentes*. These authors described a relatively restricted distribution, between Arrowsmith and White Point, for *E. zopherophloia* (Brooker & Hopper 1993).

Brooker (2000) gave a brief description of the series *Accedentes* in which he introduced a further character, the flanged seeds. Our observations indicate that this character is at best variable in the series, and cannot be regarded as diagnostic.

Taxonomy

Eucalyptus ser. **Accedentes** Chippend., *Fl. Austral.* 19: 495 (1988). *Type*: *Eucalyptus accedens* W.Fitzg.

Lignotubers present; essential oil 4-methyl-2-pentyl acetate (MPA) absent; pith glands present; cotyledons bisected; seedling leaves petiolate, disjunct after a few pairs; inflorescences axillary, single, held erect; stamens white, inflexed in bud; style tapering towards top and not articulate at base; ovules in 4 vertical rows; seeds grey-brown, compressed-ovoid to compressed-spherical, nearly smooth.

A series of nine species, eight of which are endemic to Western Australia and one (*E. trivalva*) with a widespread distribution in arid regions of Western Australia, south-east to Lake Gairdner in western South Australia and in the southern Northern Territory.

Further subdivision of the series into natural subseries is not considered feasible based on available data and knowledge of the series.

Eucalyptus ser. *Accedentes* is part of the large, predominantly southern Australian *E.* sect *Bisectae* Maiden ex Brooker. The section is diagnosed exclusively by bisected cotyledons, although the monophyly of the section has been questioned (Steane *et al.* 2002). We regard that *E.* ser. *Accedentes* is most closely related to the following series: *E.* ser. *Elongatae* Blakely (five taxa) which differs in the erect or pendulous inflorescences, white, yellow or red staminal filaments, and ovules in six or eight vertical rows; *E.* ser. *Loxophlebae* Chippend. (seven taxa) which differs in the variable presence of essential oil 4-methyl-2-pentyl acetate and narrowed or articulate style base; *E.* ser. *Stricklandianae* Brooker (two taxa) which differs in the absence of a lignotuber, variable presence of essential oil MPA, yellow staminal filaments and red-brown seeds; and the monotypic *E.* ser. *Obliquae* Blakely (*E. grossa* F.Muell.) which differs in the yellow staminal filaments, rigidly down-turned inflorescences, and ovules in six vertical rows.

Key to the taxa of *Eucalyptus* series *Accedentes*

1. Tree; bark completely smooth
2. Adult leaves greyish; flower buds 4–7 mm long .... **E. accedens**
2: Adult leaves green; flower buds 4–5 mm long .... **E. laeliae**
1: Mallee (rarely a poorly-formed tree with some rough bark); bark smooth or rough
3. Adult leaves 15–40 mm wide, dull and bluish; branchlets pruinose or not
4. Flower buds 14–17 mm long; fruit 10–12 mm long .... **E. pruiniramis**
4: Flower buds 7–11 mm long; fruit 5–9 mm long .... **E. trivalva**
3: Adult leaves 4–20 mm wide, dull or glossy, green to slightly bluish; branchlets never pruinose
5. Bark smooth or mostly smooth
6. Fruit cupular to cylindrical; valves to rim level .... **E. pilbarensis**
6: Fruit obconical; valves exserted .... **E. prominens**
5: Bark rough on lower stems
7. Juvenile leaves linear; adult leaves 4–7(–9) mm wide .... **E. baiophylla**
7: Juvenile leaves ovate to lanceolate; adult leaves 7–25 mm wide
8. Bark rough over most of stems, tightly held .... **E. zopherophloia**
8: Bark rough over lower stems only, loosely held .... **E. leprophloia**

Eucalyptus baiophylla D.Nicolle & Brooker, *sp. nov.*

A *Eucalypto prominenti* Brooker cortice aspero in caulibus inferioribus, foliis juvenilibus angustioribus, adultis angustioribus generaliter minoribus, alabastris minoribus, fructibus minus obconicis valvis minus exsertis, et habitione inferiore differt.

Typus: 48 km from Highway 1 on road to Exmouth, Western Australia, 28 October 1983, *K. Hill* 398, *L. Johnson, D. Blaxell, M.I.H. Brooker & W. Edgecombe* (*holo*: PERTH 01365274; *iso*: CANB, NSW).

Eucalyptus sp. Giralia Range (M.E. French 195), Western Australian Herbarium, in *FloraBase*, http://florabase.dec.wa.gov.au [accessed January 2008].

Eucalyptus giraliensis L.A.S.Johnson ms, in Council of Heads of Australasian Herbaria, *Australian Plant Census*, http://www.chah.gov.au/apc/index.html [accessed January 2008]; in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 371 (2000).

Eucalyptus prominens subsp. *galea* D.Nicolle ms, in Council of Heads of Australasian Herbaria, *Australian Plant Census*, http://www.chah.gov.au/apc/index.html [accessed January 2008].

Differs from *E. prominens* in the rough bark on the lower stems, the narrower juvenile leaves, the narrower and generally smaller adult leaves, the smaller flower buds, the less obconical fruits with less exserted valves, and the low-land habitat.

Mallee, often of sprawling and at times decumbent habit, 1–4 metres tall; lignotuber present. *Bark* rough on lower parts to all of stems, loose-fibrous. *Seedling leaves* becoming disjunct after a few pairs, linear, to 75 mm long × 6 mm wide, dull, blue-green. *Adult leaves* petiolate, held erect; lamina concolorous, dull to moderately glossy, green, linear, 50–85 mm long × 4–7(–9) mm wide. *Inflorescences* axillary, unbranched, held erect, 5–7-flowered; peduncles angular to slightly flattened and distally broadened, 3–6 mm long; pedicels slightly angular, 0.5–2 mm long. *Flower buds* ovoid, 7–9 mm long × 3.5–4.5 mm wide; opercula hemispherical to bluntly conical, equal in length to hypanthia. *Flowers* white; all stamens fertile. *Fruits* obconical to somewhat barrel-shaped, 5–9 mm long × 6–10 mm wide; disc descending, 1–2 mm wide; valves (3)4, slightly below rim level to slightly exserted. *Seeds* brown, compressed-ovoid to compressed-spherical, slightly flanged, with a shallow reticulum. (Figure 1)

Selected specimens. WESTERN AUSTRALIA: *c.* 5 km west of Giralia homestead, 24 Apr. 1974, *M.I.H. Brooker* 4569 (AD, CANB, PERTH); 20 km N of Waroora r/o [Warroora t/o] on new Exmouth road, 14 Apr. 1977, *M.I.H. Brooker* 5687 (AD, CANB, NSW, PERTH); 12 km N of Warroora turnoff on Coral Bay Road, 15 Apr. 1977, *M.I.H. Brooker* 5697 (PERTH); road to Exmouth, NW of Minilya Bridge, 28 Oct. 1983, *M.I.H. Brooker* 8306 (AD, CANB); Warroora Station, Exmouth Road, 6 July 1997, *M.E. French* 195 (PERTH); Warroora Station, Exmouth Road, 6 July 1997, *M.E. French* 196 (PERTH); Warroora Station 5 km ex Exmouth Road ex NTA, 6 July 1997, *M.E. French* 199, 200 (PERTH); 27.7 km E of main Exmouth road on track to Giralia (10.1 km W of homestead), 29 Oct. 1983, *K. Hill* 416, *L. Johnson, D. Blaxell, M.I.H. Brooker & W. Edgecombe* (AD, CANB, NSW, PERTH); 10.4 km W of the Giralia Homestead entrance on the Burkett Road, 3 Aug. 1986, *S.D. Hopper* 5053 (PERTH); Giralia Range, 10.5 km W of 'Giralia' homestead on road to 'Bullara', 4 Aug. 1991, *L.A.S. Johnson* 9354 & *B.G. Briggs* (CANB, NSW, PERTH); near Cape Farquhar, on coastal track between Gnaraloo and Warroora Stations, 28 Nov. 1994, *D. Nicolle* 1181 (CANB, PERTH); Cardabia Station, 17 June 1981, *A. Payne* 66 (PERTH); Quobba Station, 26 Nov. 1981, *A. Payne* 196 (PERTH).

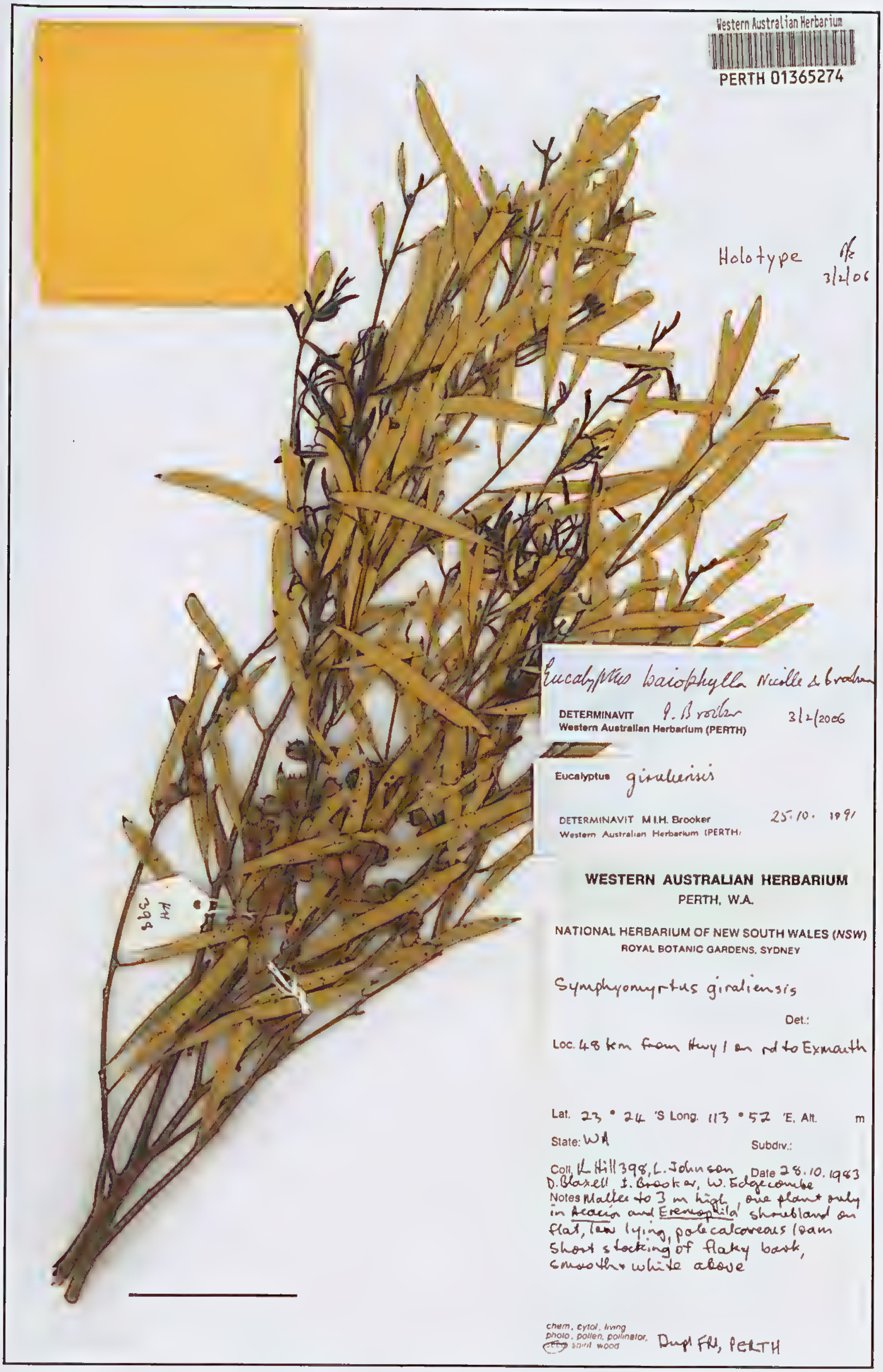
Western Australian Herbarium
PERTH 01365274
Holotype 3/2/06
Eucalyptus baiophylla Nicolle & Brooker
DETERMINAVIT I. Brooker 3/2/2006
Western Australian Herbarium (PERTH)
Eucalyptus giralensis
DETERMINAVIT M.I.H. Brooker 25.10.1991
Western Australian Herbarium (PERTH)
WESTERN AUSTRALIAN HERBARIUM
PERTH, W.A.
NATIONAL HERBARIUM OF NEW SOUTH WALES (NSW)
ROYAL BOTANIC GARDENS, SYDNEY
Symphyomyrtus giraliensis
Det.:
Loc. 48 km from Hwy 1 on rd to Exmouth
Lat. 23° 24 'S Long. 113° 52 'E. Alt. m
State: WA
Subdiv.:
Coll. K. Hill 398, L. Johnson Date 28.10.1983
D. Blaxell, I. Brooker, W. Edgecombe
Notes Mallee to 3 m high, one plant only in Acacia and Eremophila shrubland on flat, low lying, pale calcareous loam
Short stocking of flaky bark, smooth white above
chem, cytol, living
photo, pollen, pollinator,
seed, spirit wood
Dupl FRI, PERTH
KH 398

Figure 1. Holotype of *Eucalyptus baiophylla* (*K. Hill* 398, *L. Johnson, D. Blaxell, M.I.H. Brooker & W. Edgecombe*), scale = 5 cm

Distribution and habitat. Of widespread but relatively scattered distribution centered about the Giralia Range between Exmouth Gulf and Lake MacLeod, in far western Australia (Figure 2). The species occurs on red or white sand or loam over limestone, often on low stony rises (Figure 3), where it is often the only eucalypt species present, although it has been recorded to be associated with *E. fruticosa* Brooker.

Conservation status. Eucalyptus baiophylla is scattered in a relatively remote area and is not considered to be at risk. It has not been recorded from any national parks or nature reserves. Populations of mallees in Kalbarri and Zuytdorp National Parks, variously attributed to *E. prominens* (Kelly *et al.* 1995) or this new species are considered here to represent a northern extension to the distribution of *E. zopherophloia* (see below), and appear typical for that species.

Etymology. The specific name is derived from the Greek *baios* (little) and *phyllon* (a leaf), and refers to the small juvenile and particularly adult leaves of this species in contrast to the related *E. zopherophloia* and *E. prominens*.

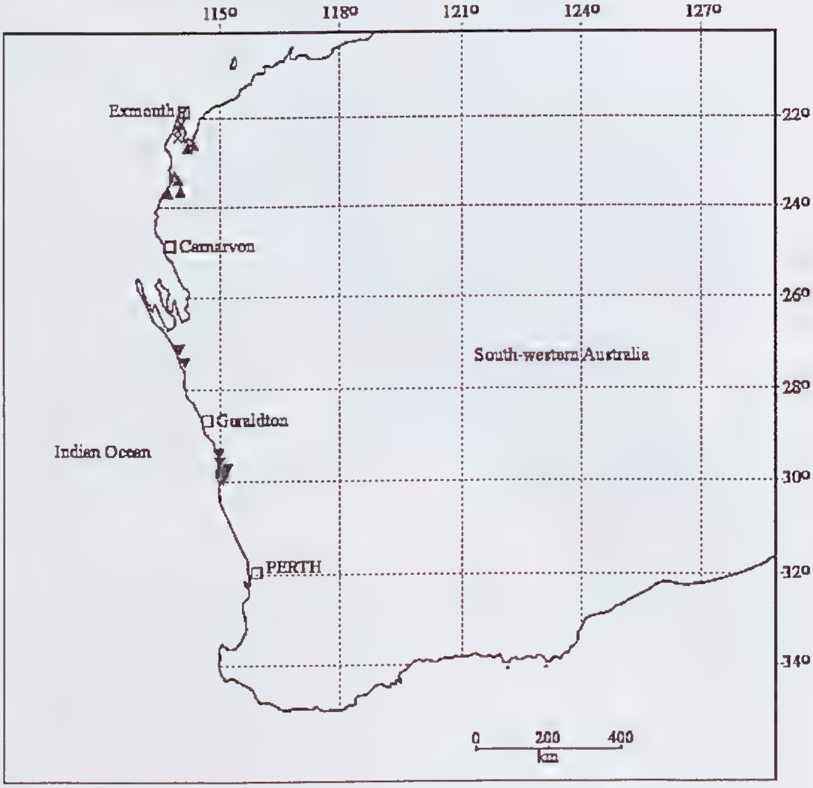

Figure 2. Distribution of *Eucalyptus baiophylla* (▲), *E. zopherophloia* (▼) and *E. prominens* (×) in south-western Australia.

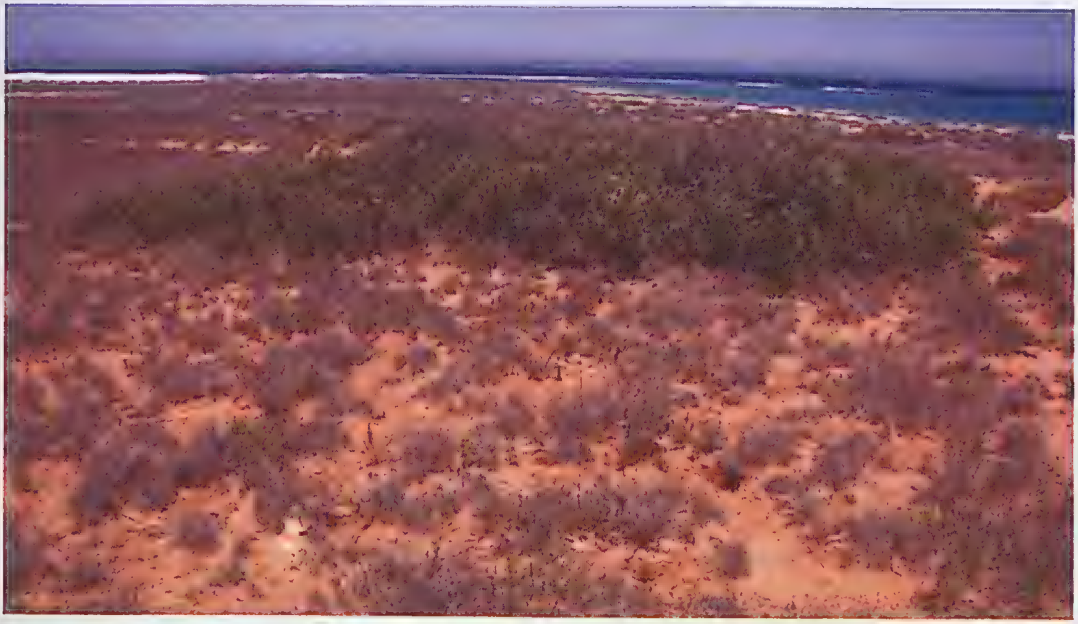

Figure 3. *Eucalyptus baiophylla* habit and habitat (*D. Nicolle* 1181; near Cape Farquhar, on coastal track between Gnaraloo and Warroora Stations).

Notes. The new species appears to link *E. prominens* with *E. zopherophloia*, both morphologically (as evidenced by some degree of intermediacy of characters) and geographically (Figure 2).

Eucalyptus baiophylla was included in *E. prominens* by Brooker and Kleinig (2004). It differs from *E. prominens* in the often lower, more sprawling habit, the rough bark on the lower stems (mostly smooth-barked in *E. prominens*), the shorter and narrower juvenile leaves (to 110 mm long and to 14 mm wide in *E. prominens*), the narrower and often shorter adult leaves (8–20 mm wide and 70–120 mm long in *E. prominens*), the smaller buds (8–13 mm long and 5–7 mm wide in *E. prominens*) and the often less obconical fruits with less exserted valves (always obconical and valves strongly exserted in *E. prominens*). *Eucalyptus prominens* is of more restricted distribution than *E. baiophylla*, occurring only near Exmouth where it occurs on the higher ground of the limestone slopes and plateaux of the Cape Range, in contrast to the lowland habitat of the new species.

Although commonly included in *E. prominens*, *E. baiophylla* is considered here to be more closely related to *E. zopherophloia*. It differs from *E. zopherophloia* in its linear juvenile leaves (lanceolate to broad-lanceolate in *E. zopherophloia*), narrower and often shorter adult leaves (7–14 mm wide and 60–100 mm long in *E. zopherophloia*), generally shorter peduncles (to 13 mm long in *E. zopherophloia*) and pedicels, and more prominent valves of the fruit (valves to rim level in *E. zopherophloia*). *Eucalyptus zopherophloia* is of a more southern distribution, occurring from near Dongara northwards to the Zuytdorp Cliffs, where it occurs on coastal sands over limestone, similar to the habitat of *E. baiophylla*. The inclusion of populations from Kalbarri and Zuytdorp National Parks (north of Geraldton) in *E. zopherophloia* considerably extends the distribution of the species, which was previously only known from between Arrowsmith and White Point (south of Geraldton; Brooker & Hopper 1993).

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A revision of *Eucalyptus* ser. *Cornutae* subser. *Conjunctae* (Myrtaceae) from the south coast of Western Australia, including the description of four new taxa and comments on the hybrid origin of *E. bennettiae*

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Abstract

Nicolle, D., French, M. & McQuoid, N. A revision of *Eucalyptus* ser. *Cornutae* subser. *Conjunctae* (Myrtaceae) from the south coast of Western Australia, including the description of four new taxa and comments on the hybrid origin of *E. bennettiae*. *Nuytsia* 18: 197–222 (2008). Eight terminal taxa are recognised in *Eucalyptus* L'Hér. ser. *Cornutae* (Benth.) Brooker subser. *Conjunctae* Brooker. Two new species are described, viz., *E. sinuosa* D.Nicolle, M.E.French & McQuoid, known from only a few populations in the Corackerup Creek area and in Fitzgerald River National Park, and *E. retusa* D.Nicolle, M.E.French & McQuoid, known from one or possibly two populations from near Bremer Bay. New subspecies described are *E. lehmannii* (Schauer) Benth. subsp. *parallela* D.Nicolle & M.E.French, which is the widespread variant of the species, occurring from the Stirling Range area eastwards to Cape Arid, and *E. conferruminata* D.Carr & S.Carr subsp. *recherche* D.Nicolle & M.E.French, the eastern variant of that species apparently endemic to the Recherche Archipelago and the common variant in cultivation across southern Australia. The distribution of *E. arborella* Brooker & Hopper is modified with the discovery of a new population and the exclusion of another population included in this species by others. The hybrid status of *E. bennettiae* D.Carr & S.Carr is discussed. A key to *E.* subser. *Conjunctae* is provided.

Introduction

We recognise eight terminal taxa within *Eucalyptus* L'Hér. subser. *Conjunctae* Brooker. These are unique in the genus due to their fused hypanthia, readily seen in the flower bud and fruit stage. Indeed, the taxon *Symphyomyrtus* (Schauer) Brooker, first described as a new genus in 1844 and now universally recognised as the largest subgenus in the eucalypts, and for which *E. lehmannii* (Schauer) Benth. (one of the species of *E.* subser. *Conjunctae*) is the type, literally means 'fused myrtle'. Of course, although the name is most appropriate for *E. lehmannii* and the other taxa of *E.* subser. *Conjunctae*, it is not apt for the majority of taxa now included in *E.* subg. *Symphyomyrtus*.

The species in *E.* subser. *Conjunctae* are also distinctive in their variably long and conspicuous opercula, very large inflorescences of yellowish green, erect stamens, and fruits which are fused into relatively large, woody, more or less rounded clusters with long, sharp and relatively strong style remnants and valves, giving the fruiting inflorescences a ‘spiky’ look and feel.

Eucalyptus subser. *Conjunctae* is restricted to the coastal and subcoastal areas of southern Western Australia, with the distribution centred on Fitzgerald River National Park, which is well-known for its very high taxonomic diversity of vascular plants. Indeed, five of the six species recognised in the subseries occur within the national park (with *E. retusa* D.Nicolle, M.E.French & McQuoid occurring just outside it in a recreation reserve).

Some taxa of the subseries are widely grown in cultivation, at least in southern Australia, particularly *E. conferruminata* D.Carr & S.Carr subsp. *recherche* D.Nicolle & M.E.French and to a lesser extent *E. lehmannii* . Furthermore, *E. mcquoidii* Brooker & Hopper, *E. retusa* and particularly *E. sinuosa* D.Nicolle, M.E.French & McQuoid (the latter two newly described here) have potential for horticultural use, due to their generally diminutive and compact habit, large inflorescences, unusual flower buds and fruits, and tolerance of coastal conditions.

The subseries is placed and defined in the genus as follows (following Brooker 2000): *Eucalyptus* subg. *Symphyomyrtus* (cotyledons folded in seeds; buds bi-operculate; seeds with ventral or terminal hilum; seed coat formed from both integuments) sect. *Bisectae* Maiden ex Brooker (cotyledons bisected; inflorescences axillary) subsect. *Hadrotes* Brooker (cotyledons coarsely bisected; buds and fruits large and coarse) ser. *Cornutae* (Benth.) Brooker (pith of branchlets with glands; seedling leaves scabrid) subser. *Conjunctae* (hypanthia of flower buds and fruits fused together).

Brooker (2000) recognised two subseries within *E.* ser. *Cornutae,* of which subser. *Liberae* Brooker has similarly large inflorescences of yellowish green flowers, but differs from subser. *Conjunctae* primarily in the free (non-fused) hypanthia of the inflorescence. *Eucalyptus* subser. *Liberae* has four species (*E. burdettiana* Blakely & Steedman, *E. megacornuta* C.Gardner, *E. newbeyi* D.Carr & S.Carr and *E. talyuberlup* D.Carr & S.Carr) with a similar distribution to that of subser. *Conjunctae.*

Key to the taxa of *Eucalyptus* subser. *Conjunctae*

1. Peduncles flattened in flower buds

2. Peduncles 10–28 mm wide; opercula 8–21 mm wide at base

3. Opercula mostly >12 mm wide at base .... **1a. E. conferruminata** subsp. **conferruminata**

3: Opercula mostly <12 mm wide at base .... **1b. E. conferruminata** subsp. **recherche**

2: Peduncles 5–12 mm wide; opercula 3–10 mm wide at base

4. Obligate seeder; infructescences 44–52 mm diam. ....**2. E. arborella**

4: Resprouter; infructescences 32–46 mm diam.

5. Adult leaves elliptic to ovate, 16–27 mm wide ....**5a. E. lehmannii** subsp. **lehmannii**

5: Adult leaves linear to narrowly elliptic, 8–14 mm wide ....**5b. E. lehmannii** subsp. **parallela**

1: Peduncles terete in flower buds

6. Adult leaves obovate to spathulate, 14–20 mm wide and often retuse at tip .... **6. E. retusa**

6: Adult leaves linear to narrowly spathulate, 4–10 mm wide, acuminate at tip

  7. Obligate seeder; opercula straight or weakly curved near tip, 50–60 mm long .... **3. E. mcquoidii**

  7: Resprouter; opercula sinuous, 50–95 mm long .... **4. E. sinuosa**

Taxonomy

1. Eucalyptus conferruminata D.Carr & S.Carr, *Austral. J. Bot.* 28: 535 (1980).

Type: Middle Mt Barren, Western Australia, 16 July 1970, *A.S. George* 10097 (*iso*: PERTH 01378147, 01378120, 01377728, 01377701, 01378139).

Distinguished within the subseries by its combination of non-lignotuberous habit (obligate seeder); elliptic to elongate-elliptic, acuminate adult leaves; short, strongly flattened peduncles; fully fused hypanthia; large buds with thick, straight and blunt-tipped opercula; and large fruits.

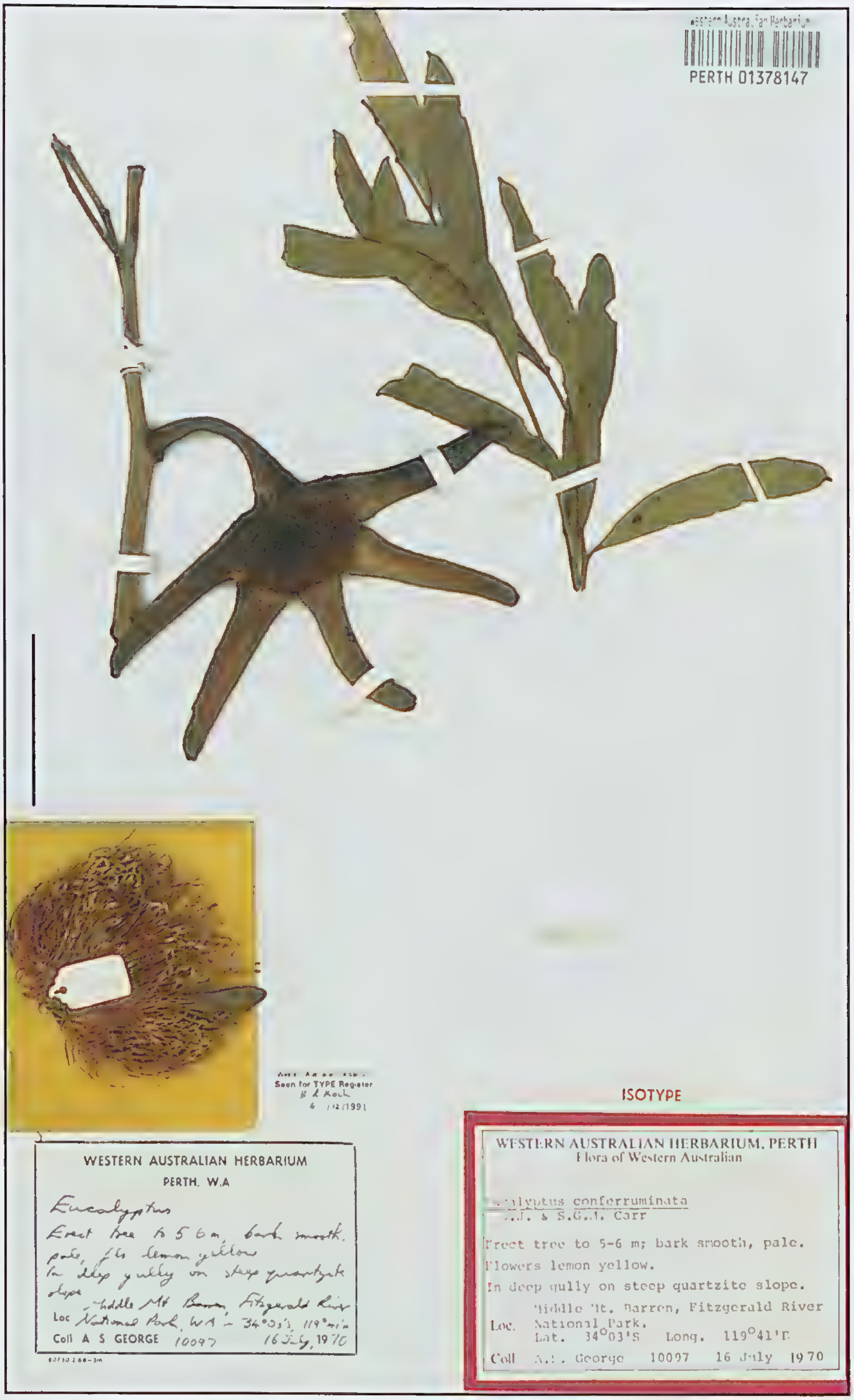
Dense *shrub* or bushy-crowned *mallet*, 1–5 m tall, lignotuber absent (obligate seeder). *Bark* smooth throughout, light grey to tan over pale yellow to cream, decorticating in strips and short ribbons. *Seedling leaves* opposite for 1 or 2 pairs then becoming disjunct, ovate to orbicular-ovate, to 50 mm long by 38 mm wide, scabrous, slightly discolorous, dull, light green. *Adult leaves* shortly petiolate, held somewhat erect; lamina elliptic to elongate elliptic, mucronate, 48–93 mm long × 13–32 mm wide, glossy, light green; reticulation sparse to moderate with scattered intersectional oil glands; lenticels absent. *Inflorescences* axillary, unbranched, sessile and fully fused; 7–19-flowered; peduncles distinctly flattened and distally thickened, 22–48 mm long, 10–28 mm wide. *Flower buds* with hypanthia sessile and fully fused; opercula finger-shaped, blunt-tipped, 34–55 mm long × 8–21 mm wide at base, straight, rounded but never swollen at tip. *Flowers* yellow-green. *Fruits* sessile and fused, infructescences to 65 mm in diameter (excluding valves; to 90 mm diameter including valves); individual fruits 14–25 mm wide at rim; disc ascending; valves 3, strongly exserted and with persistent style remnants. (Figure 1)

Two allopatric subspecies are recognised, differing primarily in the size of the buds and fruits.

1a. Eucalyptus conferruminata subsp. **conferruminata**

Adult leaf lamina elliptic to elongate-elliptic, 48–93 mm long × 16–32 mm wide. *Inflorescences* 7–15(–17)-flowered; peduncle 20–48 mm long × 12–28 mm wide. *Flower buds* with opercula 36–55 mm long × (10–)12–21 mm wide at base. *Infructescences* to 60 mm in diameter (excluding valves). *Individual fruits* 14–25 mm wide at rim; disc ascending. (Figures 1, 2)

Selected specimens examined (west to east). WESTERN AUSTRALIA: Bald Head, Flinders Peninsula, Torndirrup, 25 km S of Albany, 16 Dec. 1986, *G.J. Keighery* 8610 (PERTH); 1.5 miles SE of Middle Mt Barren, 21 Mar. 1970, *K.R. Newbey* 3136 (PERTH); 200 m E down gully, near Quoin Head, Fitzgerald River National Park, 4 Nov. 2000, *D. Nicolle* 3570 *& M. French* (CANB, PERTH). Bald Head, Flinders Peninsula, S of Albany, 24 Sep. 2004, *D. Nicolle* 4805 *& M. French* (AD, CANB, PERTH).



Seen for TYPE Register
B L Koch
6 /12/1991

WESTERN AUSTRALIAN HERBARIUM
PERTH. W.A
Eucalyptus
Erect tree to 5 6 m, bark smooth, pale, fls lemon yellow
In deep gully on steep quartzite slope
Loc Middle Mt Barren, Fitzgerald River National Park, WA – 34°03'S, 119°41'E
Coll A S GEORGE 10097 16 July, 1970

ISOTYPE

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australian
alyptus conferruminata
.J. & S.G.M. Carr
Erect tree to 5-6 m; bark smooth, pale.
Flowers lemon yellow.
In deep gully on steep quartzite slope.
Loc. Middle Mt. Barren, Fitzgerald River National Park.
Lat. 34°03'S Long. 119°41'E
Coll A.S. George 10097 16 July 1970

Figure 1. Isotype of *Eucalyptus conferruminata* subsp. *conferruminata*, scale = 5 cm.

Distribution and habitat. Known only from a few sites on the south coast of Western Australia, at Bald Head south of Albany, and a few small populations between Middle Mount Barren and the Whoogarup Range in the central coastal area of Fitzgerald River National Park. All sites are very coastal and exposed to persistent and at times strong, salt-laden winds (Figure 2). The subspecies often occurs in small pure stands or as the only eucalypt among other coastal taxa, but has also been recorded growing with *Eucalyptus mcquoidii* and *E. preissiana* subsp. *preissiana*.

Eucalyptus conferruminata has been reported from Bald Island, approximately 50 km east-north-east of Albany (Gardner 1960; Sarah Comer, Department of Environment and Conservation, Albany, pers. comm.), hence the occasionally used common name 'Bald Island marlock'. However, the authors have not seen herbarium specimens collected from the island nor verified the island population in the field. The taxon may also occur at Two Peoples Bay, between Albany and Bald Island, with *E. conferruminata* described as occurring '…from Two Peoples Bay east to beyond Esperance…' by Brooker and Kleinig (2001). A targeted search for the taxon around Mt Gardner in the Two Peoples Bay area by one of us (NMQ) in June 2007 revealed no typical *E. conferruminata*, although populations displaying intermediate morphology between *E. cornuta* and *E. conferruminata* were observed and collected at several sites near Mt Gardner. We consider these populations to represent intergrades between *E. cornuta* and *E. conferruminata* due to the variably intermediate habit, bark and reproductive morphology. Although we cannot confirm 'pure' *E. conferruminata* from the Two Peoples Bay area, these variable intermediates indicate that *E. conferruminata* may remain undetected in the general area, and/or that *E. conferruminata* once occurred in the area in the past but has since been genetically swamped by *E. cornuta*, which has a wider but scattered distribution in the area. The latter hypothesis is analogous to the apparent genetic swamping of *E. retusa* by the more common *E. cornuta* at Hood Point.

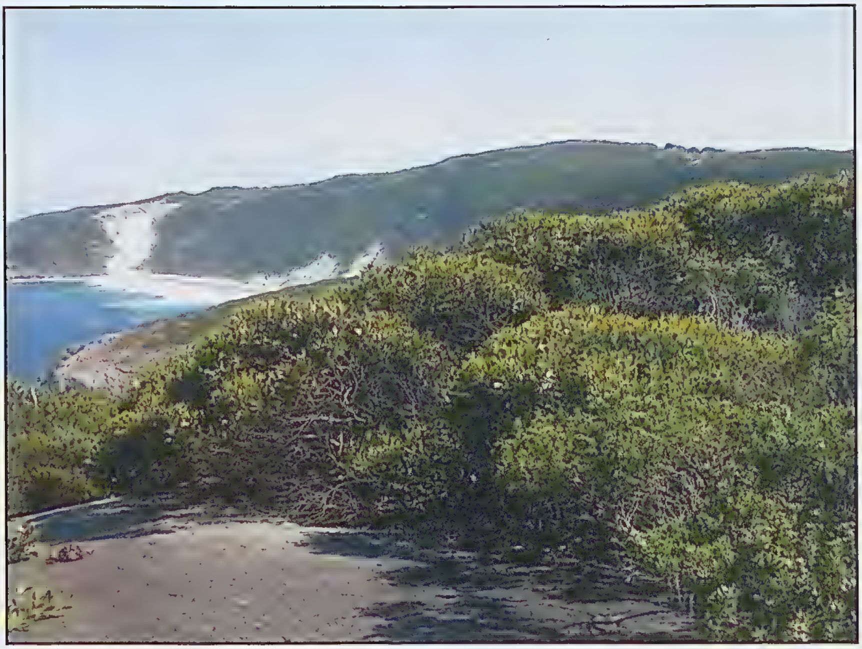


Figure 2. Habitat and habit of *Eucalyptus conferruminata* subsp. *conferruminata* (Bald Head, Flinders Peninsula, S of Albany, *D. Nicolle* 4805 *& M. French).*

Conservation status. Only known from a handful of small populations, mostly or entirely within conserved areas. Recorded from Torndirrup and Fitzgerald River National Parks.

Notes. *Eucalyptus conferruminata* subsp. *conferruminata* is the western variant of the species, differing from subsp. *recherche* in the coarser adult leaves, flower buds and fruits. Natural populations of the two subspecies are geographically separated by approximately 120 km (between Quoin Head, which is the eastern extent of subsp. *conferruminata,* and Sandy Hook Island, which is the western extent of subsp. *recherche*) and intergradation between the two subspecies is therefore not known.

Eucalyptus conferruminata subsp. *conferruminata* is rarely seen in cultivation (*cf.* subsp. *recherche*).

1b. Eucalyptus conferruminata subsp. **recherche** D. Nicolle & M.E.French, *subsp. nov.*

A subspecie typica foliis adultis, alabastris fructibusque validioribus et parvioribus differt.

Typus: higher slopes of western section of Woody Island, south-east of Esperance, 33° 58' 03" S, 122° 00' 50" E, 24 February 2001, *M. French* 1263 (*holo*: PERTH 05999596; *iso*: AD, CANB).

Eucalyptus conferruminata subsp. Recherche Archipelago (D. Nicolle & M. French DN 4585), in Council of Heads of Australasian Herbaria, *Australian Plant Census*, http://www.chah.gov.au/apc/index.html [accessed 28 May 2008].

Eucalyptus lehmannii subsp. *recherchensis* D.Nicolle ms, in Council of Heads of Australasian Herbaria, *Australian Plant Census*, http://www.chah.gov.au/apc/index.html [accessed 28 May 2008].

Adult leaf lamina elongate-elliptic, 50–85 mm long × 11–27 mm wide. *Inflorescences* 13–19-flowered; peduncle 18–32 mm long × 10–14 mm wide. *Flower buds* with opercula 34–40 mm long × 8–11 mm wide at base. *Infructescences* to 50 mm in diameter (excluding valves). *Individual fruits* 12–19 mm wide at rim; disc slightly ascending to ascending. (Figure 3)

Selected specimens examined. (west to east). WESTERN AUSTRALIA: Sandy Hook Island, near Esperance, 1 May 1982, *M.I.H. Brooker* 7491 (CANB, PERTH); along path to Skinny Dip Bay, E end of Woody Island, Recherche Archipelago, 18 Nov. 1998, *M. Hislop* 1222 (PERTH); Archipelago of the Recherche, Sandy Hook Island, 1 May 1982, *S.D. Hopper* 2236 (PERTH); slope on S side of peak, North Twin Peak Island, Recherche Archipelago, 5 Mar. 2003, *D. Nicolle* 4585 *& M. French* (AD, CANB, PERTH); E side of Flinders Peak, Middle Island, Recherche Archipelago, 6 Mar. 2003, *D. Nicolle* 4588 & M. French (CANB, PERTH); NW side of Mondrain Island, Recherche Archipelago, 8 Mar. 2003, *D. Nicolle* 4596 & M. French (PERTH); S side of Sandy Hook Island, Recherche Archipelago, 8 Mar. 2003, *D. Nicolle* 4603 & M. French (CANB, PERTH); W side of Woody Island, Recherche Archipelago, 10 Mar. 2003, *D. Nicolle* 4611 *& M. French* (PERTH); Middle Island, 22 Nov. 1973, *A.S. Weston* 8874 (PERTH).

Distribution and habitat. Apparently endemic to the Archipelago of the Recherche, off the south coast of Western Australia (Figure 4). Collections of this subspecies have been made from Middle, Mondrain, North Twin Peak, Sandy Hook and Woody Islands. A search for the subspecies on other islands of the archipelago in March 2003 by two of the authors (DN and MF) indicates that the subspecies is apparently absent from Observatory, Figure of Eight, South Twin Peak, Long and Salisbury Islands.

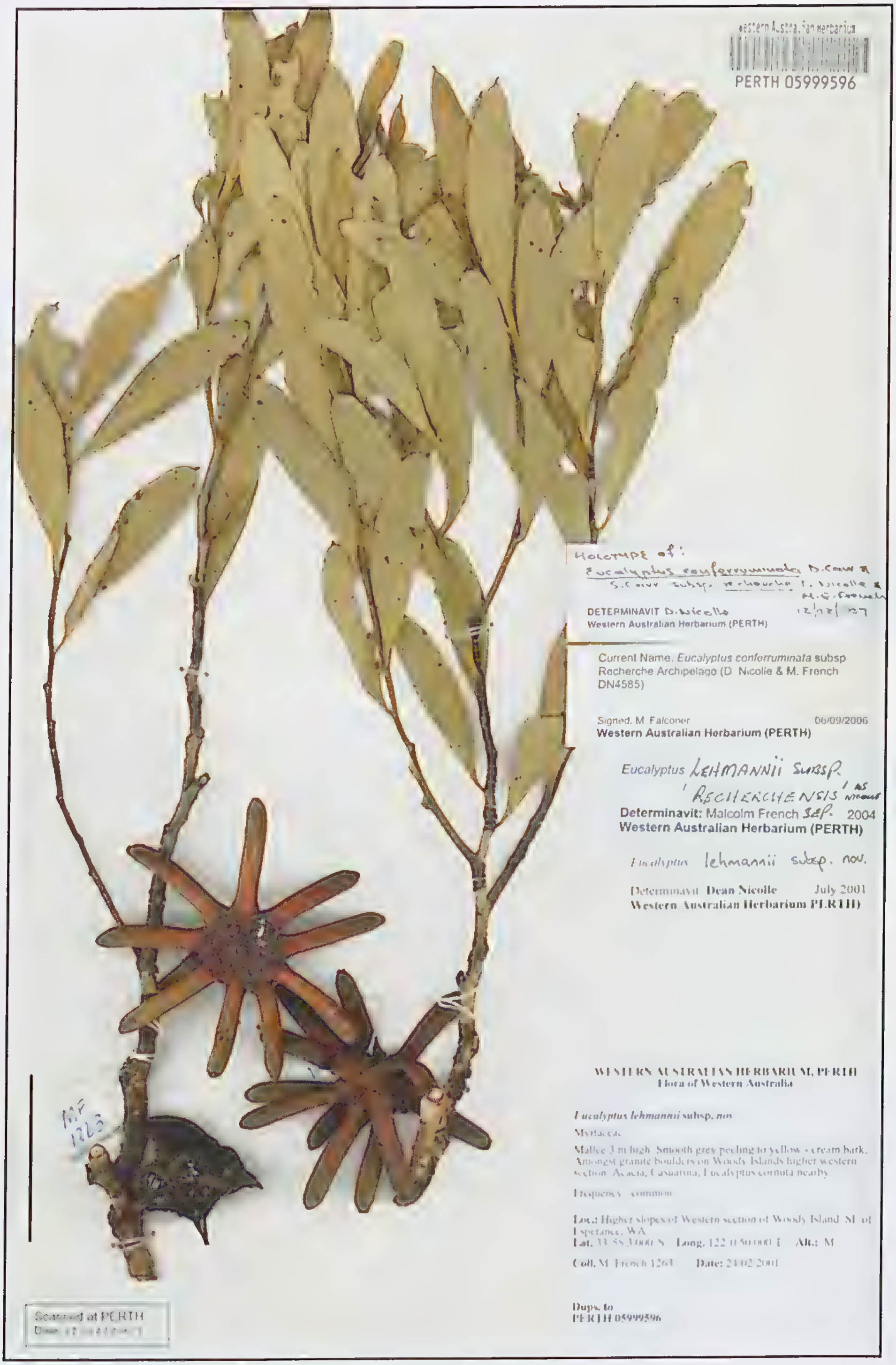

Western Australian Herbarium
PERTH 05999596
Holotype of:
Eucalyptus conferruminata D.Carr & S.Carr subsp. recherche D. Nicolle & M. French
DETERMINAVIT D. Nicolle
Western Australian Herbarium (PERTH)
Current Name. Eucalyptus conferruminata subsp Recherche Archipelago (D Nicolle & M. French DN4585)
Signed. M Falconer 06/09/2006
Western Australian Herbarium (PERTH)
Eucalyptus LEHMANNII SUBSP. 'RECHERCHENSIS' as Nicolle
Determinavit: Malcolm French Sep. 2004
Western Australian Herbarium (PERTH)
Eucalyptus lehmannii subsp. nov.
Determinavit Dean Nicolle July 2001
Western Australian Herbarium PERTH)
WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia
Eucalyptus lehmannii subsp. nov
Myrtaceae
Mallee 3 m high. Smooth grey peeling to yellow + cream bark. Amongst granite boulders on Woody Islands higher western section. Acacia, Casuarina, Eucalyptus cornuta nearby
Frequency common
Loc.: Higher slopes of Western section of Woody Island SE of Esperance, WA
Coll. M French 1263 Date: 24 02 2001
Dups. to
PERTH 05999596
MF 1263
Scanned at PERTH

Figure 3. Holotype of *Eucalyptus conferruminata* subsp. *recherche*, scale = 5 cm.

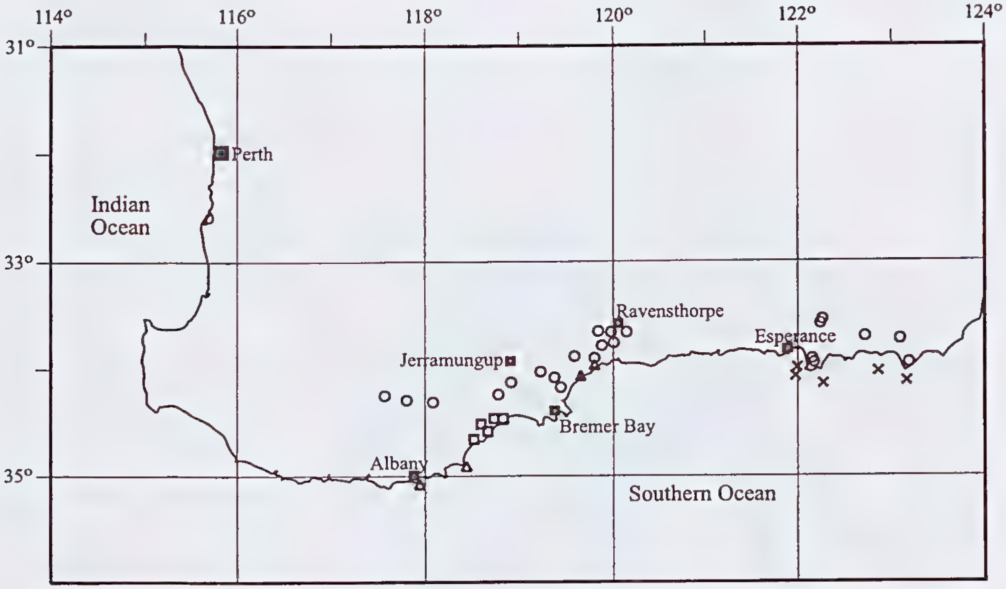


Figure 4. Distribution of *Eucalyptus conferruminata* subsp. *conferruminata* (△) and *recherche* (×) and *E. lehmannii* subsp. *lehmannii* (□) and *parallela* (○) in Western Australia.

The subspecies occurs on thin, sandy, granite-derived soils on undulating terrain and slopes, often below granite domes or hills, and is replaced by *E. utilis* on somewhat more level terrain where limestone is the parent material. The subspecies occurs in dense mallee scrub or occasionally in large pure stands (such as on Mondrain Island). Associated species include *Eucalyptus aquilina* (on Sandy Hook Island), *E. cornuta, E. goniantha* subsp. *notactites* (on Sandy Hook Island), *E. incrassata, E. insularis* (on North Twin Peak Island), *E. utilis* and *Hakea drupacea.*

Occurrences of this subspecies from the Australian mainland appear to have originated from plantings of the subspecies followed by some natural regeneration from seed (see below).

Conservation status. All known natural populations of this subspecies occur within the Archipelago of the Recherche Nature Reserve. While known from relatively few locations, the subspecies is considered well secure, with only the Woody Island populations at some threat from development associated with tourism on the island. The populations on Mondrain Island are relatively extensive in area.

Etymology. The subspecific epithet (used as a noun in apposition) is from the distribution of the subspecies, which is endemic to, and widespread in, the Archipelago of the Recherche.

Notes. *Eucalyptus conferruminata* subsp. *recherche* is the eastern variant of the species, differing from the typical subspecies in the less coarse adult leaves, flower buds and fruits. Subspecific rather than specific status is preferred for the two variants of the species, as the differences are relatively minor and it is expected that the two variants would interbreed if in geographic contact.

While *E. conferruminata* appears to be consistently killed by wildfire and is therefore an obligate seeder, populations and individuals of subsp. *recherche* occasionally develop a lignotuber, such as on

North Twin Peak Island (*D. Nicolle* 4585 & *M. French*) and more rarely on Mondrain Island (*D. Nicolle* 4596 & *M. French*). All individuals of the subspecies subjected to wildfire on Mondrain Island in 2002 were killed, regardless of presence/absence of a lignotuber (Figure 5). On North Twin Peak Island, live individuals of the subspecies were only seen as post-fire progeny from a wildfire several years earlier. The occasional presence of a lignotuber in this taxon may be caused by past and/or current genetic influence from Mainland populations of the lignotuberous *E. lehmannii,* or be due to incomplete loss of the lignotuber character from a presumably lignotuberous ancestral taxon.

Eucalyptus conferruminata subsp. *recherche* is the commonly cultivated variant of the species in coastal regions of southern Australia, and has been widely planted in farming areas of the Esperance sandplains, as well as in metropolitan areas of Perth and Adelaide. The subspecies is fast-growing and useful in sandy soils on sites subject to persistent salt-laden winds, but is susceptible to wind damage when planted in the open due to its rapid growth, dense crown and lack of a lignotuber. The typical variant of *E. conferruminata* is rarely seen in cultivation.

Under cultivated conditions the species occasionally becomes mildly weedy by short-distance seed dispersal and seedling recruitment, especially on disturbed sites. At least some individuals of this taxon within Cape Le Grand National Park appear to have originated from planted individuals and subsequent natural regeneration, e.g. southern end of Lucky Bay, Cape Le Grand National Park, 33° 59' 39" S, 122° 13' 15" E, 22 Jan. 1996, *D. Nicolle* 1639 (AD). It is possible that *E. conferruminata* subsp. *recherche* also occurs naturally in the Cape Le Grand area, but the authors have not confirmed any natural populations from the mainland.

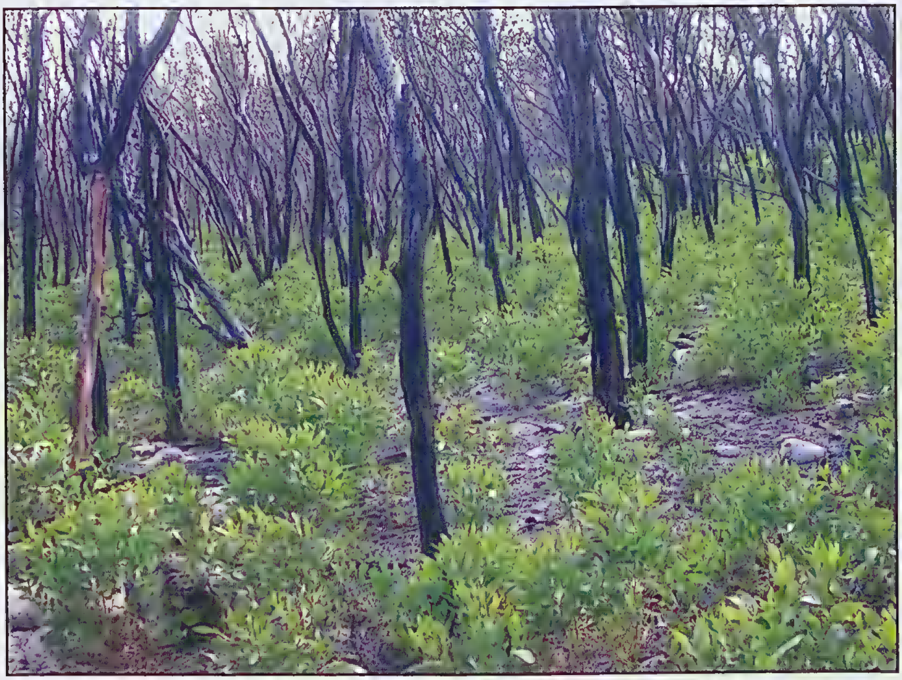


Figure 5. Seedling regeneration of *Eucalyptus conferruminata* subsp. *recherche* following wildfire (NW side of Mondrain Island, Recherche Archipelago, 8 Mar. 2003).

2. Eucalyptus arborella Brooker & Hopper, *Nuytsia* 14(3): 336 (2002). *Type*: Fitzgerald River National Park [precise locality withheld for conservation reasons], 12 March 1989, *S.D. Hopper* 7131 (*holo*: PERTH 07800576; *iso*: AD, CANB, MEL, NSW).

Eucalyptus lehmannii subsp. *arborella* Brooker & Hopper ms, in Council of Heads of Australasian Herbaria, *Australian Plant Census*, http://www.chah.gov.au/apc/index.html [accessed 28 May 2008].

Distinguished in the subseries by its combination of non-lignotuberous (obligate seeder) habit; acuminate adult leaves; long, distinctly flattened to almost terete peduncles (in fruit); fully fused hypanthia; medium-sized buds with narrow, straight and apiculate opercula; and medium-sized fruits.

Tree (mallet) 3–7 m tall, lignotuber absent (obligate seeder). *Bark* smooth throughout, dark grey to grey over pinkish-cream to almost white, decorticating in strips. *Seedling leaves* opposite for a few pairs then becoming disjunct, ovate, to 60 mm long by 28 mm wide, scabrous, discolorous, dull, light green. *Adult leaves* petiolate; lamina elongate-elliptic to lanceolate, 60–80 mm long × 12–19 mm wide, glossy, dark green; reticulation moderate with scattered intersectional oil glands; lenticels absent. *Inflorescences* axillary, fully fused, 13–21-flowered; peduncle flattened to near terete, slightly distally broadened, 50–70 mm long × 5–12 mm wide. *Flower buds* with hypanthia sessile and fully fused; opercula narrow-cylindrical, conical-tipped, 38–50 mm long × 5–10 mm wide. *Flowers* yellowish green. *Fruits* sessile and fused, infructescences to 52 mm in diameter (excluding valves; to 65 mm diameter including valves); individual fruits 11–16 mm wide at rim; disc ascending; valves 3, prominently exserted and with persistent style remnants.

Selected specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 3 Aug. 1970, *M.I.H. Brooker* 2701 (CANB, MEL, PERTH); 26 Nov. 1991, *M.I.H. Brooker* 10918 (PERTH); 18 Sep. 1999, *M.I.H. Brooker* 13035 (PERTH); 2 Dec. 2003, *M.E. French* 1563 (PERTH); 7 Apr. 1995, *S.D. Hopper* 8325 (PERTH); 23 Nov. 1994, *D. Nicolle* 1127 (PERTH); 23 Sep. 2004, *D. Nicolle* 4803 *& M. French* (CANB, PERTH).

Distribution and habitat. Eucalyptus arborella is known from only a few very scattered populations in subcoastal areas south-west and south-east of Jerramungup, in southern Western Australia (Figure 6). The species grows on the sides and tops of Eocene marine plain derived lateritic hills, jump-ups and mesas, on thin sandy soils with outcropping spongolite rock. These sites tend to be less fire prone than surrounding, more subdued topography. It occasionally grows in pure stands or associated with other obligate seeder eucalypts such as *E. astringens* subsp. *redacta*, as well as mallee species such as *E. flocktoniae* subsp. *flocktoniae*, *E. pleurocarpa* and *E. uncinata*.

Conservation status. Known from only three populations, two of which occur in Fitzgerald River National Park and a third, recently discovered population in the Corackerup Creek area. Further unrecorded populations are likely, but remain undocumented due to the species superficial similarity to *E. lehmannii* (especially subsp. *parallela*). Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora: Priority Three (Atkins 2008).

Notes. *Eucalyptus arborella* may be confused with *E. lehmannii* subsp. *parallela* in herbaria, but is easily distinguished from the latter in the field by the absence of a lignotuber. The adult leaves, buds and fruits tend to be larger in *E. arborella* than in *E. lehmannii* subsp. *parallela*. The presence/absence of a lignotuber and consequential difference in regenerative strategy is the most reliable characteristic

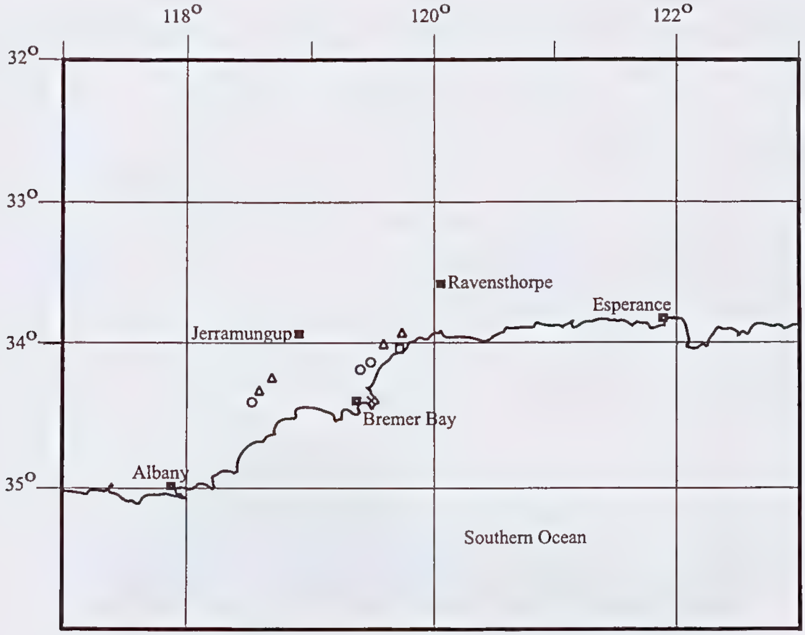


Figure 6. Distribution of *Eucalyptus arborella* (○), *E. mcquoidii* (□), *E. sinuosa* (△) and *E. retusa* (×) in Western Australia.

to distinguish the two species. The two taxa grow in close proximity in the Corackerup Creek area, with *E. arborella* occurring on the breakaways and tops of steep spongolite mesas and *E. lehmannii* subsp. *parallela* growing on more subdued sites on less skeletal soils below these mesas. Apart from the lack of a lignotuber and the somewhat larger adult leaves, buds and fruits, *E. arborella* also differs from *E. lehmannii* subsp. *lehmannii* in the narrower and longer adult leaves.

One of the populations cited as *E. arborella* by Brooker and Hopper (2002) (Fitzgerald River National Park, 500 m S of telegraph track on Quoin Head track, *S.D. Hopper* 7134, 7135) is in fact *E. lehmannii* subsp. *parallela*, as field observations indicate the population recovered from epicormic regrowth from the lignotubers following wildfire. The population occurs in a small creekline, a habitat typical of *E. lehmannii* but not *E. arborella*. This population may have been erroneously determined as *E. arborella* due to its larger status (individuals up to six metres tall prior to wildfire).

3. Eucalyptus mcquoidii Brooker & Hopper, *Nuytsia* 14(3): 336 (2002). *Type*: Fitzgerald River National Park, Western Australia [precise locality withheld for conservation reasons], 6 April 1995, *M.I.H. Brooker* 12198W (*holo*: CANB; *iso*: AD, NSW, PERTH).

Eucalyptus macquoidii Brooker & Hopper, in Council of Heads of Australasian Herbaria, *Australian Plant Census*, http://www.chah.gov.au/apc/index.html [accessed 28 May 2008].

Distinguished in the subseries by its combination of non-lignotuberous (obligate seeder) habit; linear, acuminate adult leaves with black lenticels (glands) scattered along the margins, long, terete peduncles; fully fused hypanthia; small buds with narrow, straight and apiculate-tipped to somewhat bulbous opercula; and small fruits.

Dense *shrub*, 1–4(–10) m tall, lignotuber absent (obligate seeder). *Bark* smooth throughout, decorticating in strips. *Seedling leaves* opposite for a few pairs then becoming disjunct, green. *Adult leaves* with petiole tapering to lamina, held erect; lamina glossy, green, linear to narrowly spathulate, apiculate, 60–75 mm long × 6–10 mm wide, reticulation sparse to moderate with intersectional and island oil glands, usually with minute blackened lenticels on the margins of the lamina; midrib and intramarginal veins distinct and parallel. *Inflorescences* axillary, unbranched, sessile and fused, up to 45-flowered; peduncles terete to oval in cross section, very slightly distally thickened, 25–35 mm long, 4–5 mm wide at base. *Flower buds* with hypanthia sessile and fully fused; operculum 50–60 mm long × 5–6 mm wide at base, straight or weakly curved near tip, usually swollen at tip. *Flowers* yellow-green. *Fruits* sessile and fused, infructescences 28–35 mm in diameter (excluding valves; to 45 mm diameter including valves); individual fruits 6–12 mm wide at rim; disc ascending; valves 3, strongly exserted and with persistent style remnants. (Figures 7, 8)

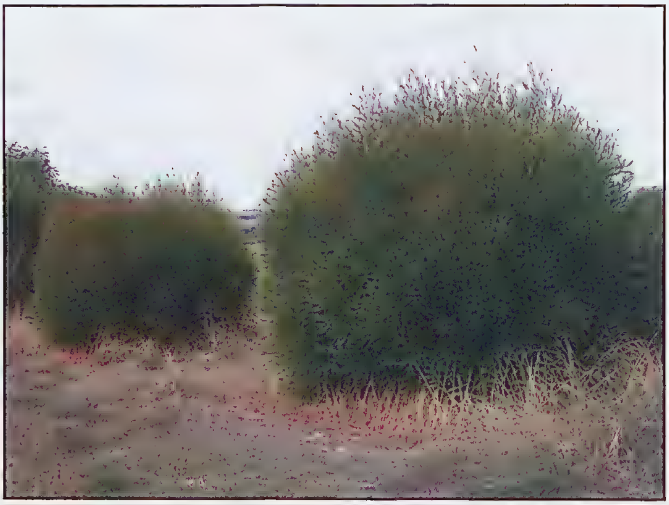


Figure 7. Four-year old plants of *Eucalyptus mcquoidii* at Currency Creek Arboretum (S.A.), grown from seed from *D. Nicolle* 3569 *& M. French*.

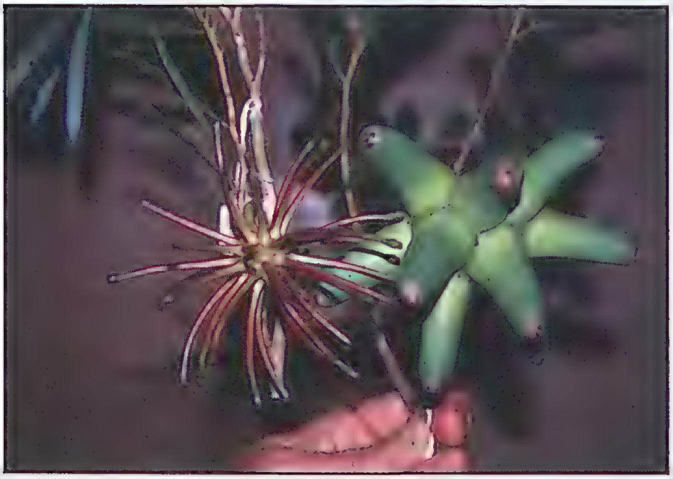


Figure 8. Mature flower bud inflorescence of *Eucalyptus mcquoidii* (LHS; *D. Nicolle* 3569 *& M. French*) and *E. conferruminata* subsp. *conferruminata* (RHS; *D. Nicolle* 3570 *& M. French*) from Quoin Head, Fitzgerald River National Park.

Selected specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 16 Feb. 1989, *N.K. McQuoid* 113 (PERTH); 8 April 1989, *N.K. McQuoid* 141 (PERTH); 4 Dec. 2000, *D. Nicolle* 3569 *& M. French* (AD, CANB, PERTH); 25 Dec. 1988, *E.M. Sandiford* A; B (PERTH).

Distribution and habitat. Known from a single population spanning several kilometres centred on Quoin Head in Fitzgerald River National Park, on the south coast of Western Australia (Figure 6). The species occurs on steep hillsides and rounded hilltops in quartz-granite sands in coastal mallee shrubland with *Eucalyptus conferruminata* subsp. *conferruminata, E. pleurocarpa, E. preissiana* subsp. *preissiana, E. redunca* and *E. uncinata.*

Conservation status. The only known population consists of at least several thousand individuals and is conserved within Fitzgerald River National Park. As the species is an obligate seeder, it is at risk of population depletion or local extinction from inappropriate fire management. DEC Conservation Codes for Western Australian Flora: Priority Two (Atkins 2008).

Notes. *Eucalyptus mcquoidii* and *E. sinuosa* share the feature of conspicuous blackened lenticels on the margins of the adult leaves, a character recorded elsewhere in the genus such as in the widespread and polymorphic mallee species *E. incrassata* Labill. The adult leaves of *E. mcquoidii* also often have lenticel-like, blackened and swollen tips.

Eucalyptus mcquoidii and *E. conferruminata* are unusual among obligate seeders in the genus in having a dense-crowned, very shrubby habit in exposed sites. Most other Western Australian obligate seeder eucalypts have a more erect habit and are known generally as mallets.

4. **Eucalyptus sinuosa** D.Nicolle, M.E.French & McQuoid, *sp. nov.*

Inter species subseriei *Conjunctarum* Brooker distinguenda habitu pluricauli ('mallee') et praesentia lignotuberis, foliis adultis angustis, lenticellis nigris marginibus dispersis, pedunculis longis teretisque, hypanthiis omnino connatis, alabastris magnis, operculis angustis sinuosisque et plerumque apice bulbosa, fructibus parvis.

Typus: Peniup Nature Reserve, south-west of Jerramungup, Western Australia [precise locality withheld for conservation reasons], 7 January 2007, *D. Nicolle* 5061 *& M. French* (*holo*: PERTH 07220650; *iso*: AD, CANB).

Eucalyptus sp. Fitzgerald River (M.I.H. Brooker 10923); *Eucalyptus petila* L.A.S.Johnson & K.D.Hill ms, in Council of Heads of Australasian Herbaria, *Australian Plant Census*, http://www.chah.gov.au/apc/index.html [accessed 28 May 2008].

Eucalyptus 'petila' Brooker & Hopper *ined.* (Kelly *et al.* 1995; 143).

Distinguished in the subseries by its combination of lignotuberous (resprouter) habit; linear adult leaves with black lenticels (glands) scattered along the margins, long and terete peduncles; fully fused hypanthia; large buds with narrow, sinuous and often bulbous-tipped opercula; and small fruits.

Mallee, 1.0–3.5 m tall, lignotuber present. *Bark* smooth throughout (sometimes ribbony-rough at the base), grey to tan over orange-tan, decorticating in strips and short ribbons. *Seedling leaves* not seen. *Adult leaves* with petiole tapering to lamina, held erect; lamina glossy, green, linear, apiculate, 50–75 mm long × 4–7(–8) mm wide, with up to 6 blackened lenticels on each margin of the lamina; midrib and intramarginal veins distinct and parallel. *Inflorescences* axillary, unbranched, sessile and fused, up to 25-flowered; peduncles terete to oval in cross section, slightly distally thickened, (45–)60–100(–140) mm long, 5–10 mm wide at base. *Flower buds* with hypanthia sessile and fully fused; operculum 50–95 mm long, sinuous, usually swollen to bulbous at tip. *Flowers* yellow-green. *Fruits* sessile and fused; infructescences 25–75 mm in diameter (including valves); individual fruits 6–16 mm wide; disc indistinct, ascending; valves 3, strongly exserted and with persistent style remnants. (Figures 9, 10, 11)

Selected specimens examined (west to east). WESTERN AUSTRALIA: [localities withheld for conservation reasons] 11 June 2003, *S. Barrett* 1097 (PERTH); 25 Nov. 1991, *M.I.H. Brooker* 10923 (CANB, PERTH); 15 June 2002, *J.A. Cochrane* 4200 (PERTH); 11 June 2003, *J.A. Cochrane* 4688, *S. Barrett & M. Grant* (K, PERTH); Feb. 1977, *T. Evans s.n.* (PERTH); 30 March 2006, *M. French* 1782 (PERTH); 30 March 2006, *M. French* 1783 (PERTH); 6 June 1989, *S.D. Hopper* 7261 (PERTH); 7 June 1989, *S.D. Hopper* 7265 (PERTH); 18 Jan. 1989, *A.C. Napier & E. Goble-Garratt* 364 (PERTH); 7 Jan. 2007, *D. Nicolle* 5057 *& M. French* (CANB, PERTH); 4 Nov. 1992, *C.J. Robinson* 997 (PERTH).

Distribution and habitat. Known from about six populations scattered in subcoastal areas of southern Western Australia, from the Corackerup Creek catchment south-east of Ongerup eastwards to the lower West River catchment in Fitzgerald River National Park, south-west of Ravensthorpe (Figure 6). Although the known populations are well scattered, the species is usually locally common or dominant where it occurs. *Eucalyptus sinuosa* grows in white granitic sands with scattered gravel on slight slopes or undulating topography in mallee or open mallee communities with other eucalypt species including *E. conglobata* subsp. *perata, E. pleurocarpa, E.* aff. *rigidula, E. sporadica, E. uncinata* and *E. xanthonema* subsp. *apposita*.

Etymology. From the Latin *sinuosus* (full of bendings; winding) referring to the distinctive and conspicuous opercula of the species.

Conservation status. Most of the known populations occur in conserved areas, including several populations in Fitzgerald River National Park and at least one population occurring in each of Peniup and Corackerup Nature Reserves. DEC Conservation Codes for Western Australian Flora: Priority Two, as *Eucalyptus* sp. Fitzgerald River (M.I.H. Brooker 10923) (Atkins 2008).

Notes. A distinctive species, both in the genus and within *E.* subser. *Conjunctae,* due to its narrow adult leaves and large flower bud inflorescences with long and narrow, sinuous opercula that are often bulbous at the tip. The species has considerable horticultural potential because of its small, fine-leaved crown, unusual flower buds (the species has the longest opercula in the genus) and large, greenish yellow flowers.

Eucalyptus sinuosa is not likely to be confused with any other species in the subseries, but is probably most closely related to *E. mcquoidii*, differing from the latter in the presence of a lignotuber (lignotuber absent in *E. mcquoidii*) and the much longer, sinuous and often bulbous-tipped opercula (shorter, straight and more apiculate opercula in *E. mcquoidii*).

Eucalyptus sinuosa and *E. mcquoidii* share the feature of conspicuous blackened lenticels on the margins of the adult leaves, a character recorded elsewhere in the genus such as in the widespread and polymorphic mallee species *E. incrassata.* This characteristic has also been observed in some populations of *E. lehmannii* subsp. *parallela* (e.g. *D. Nicolle* 4802 *& M. French*), and its diagnostic value may be limited.

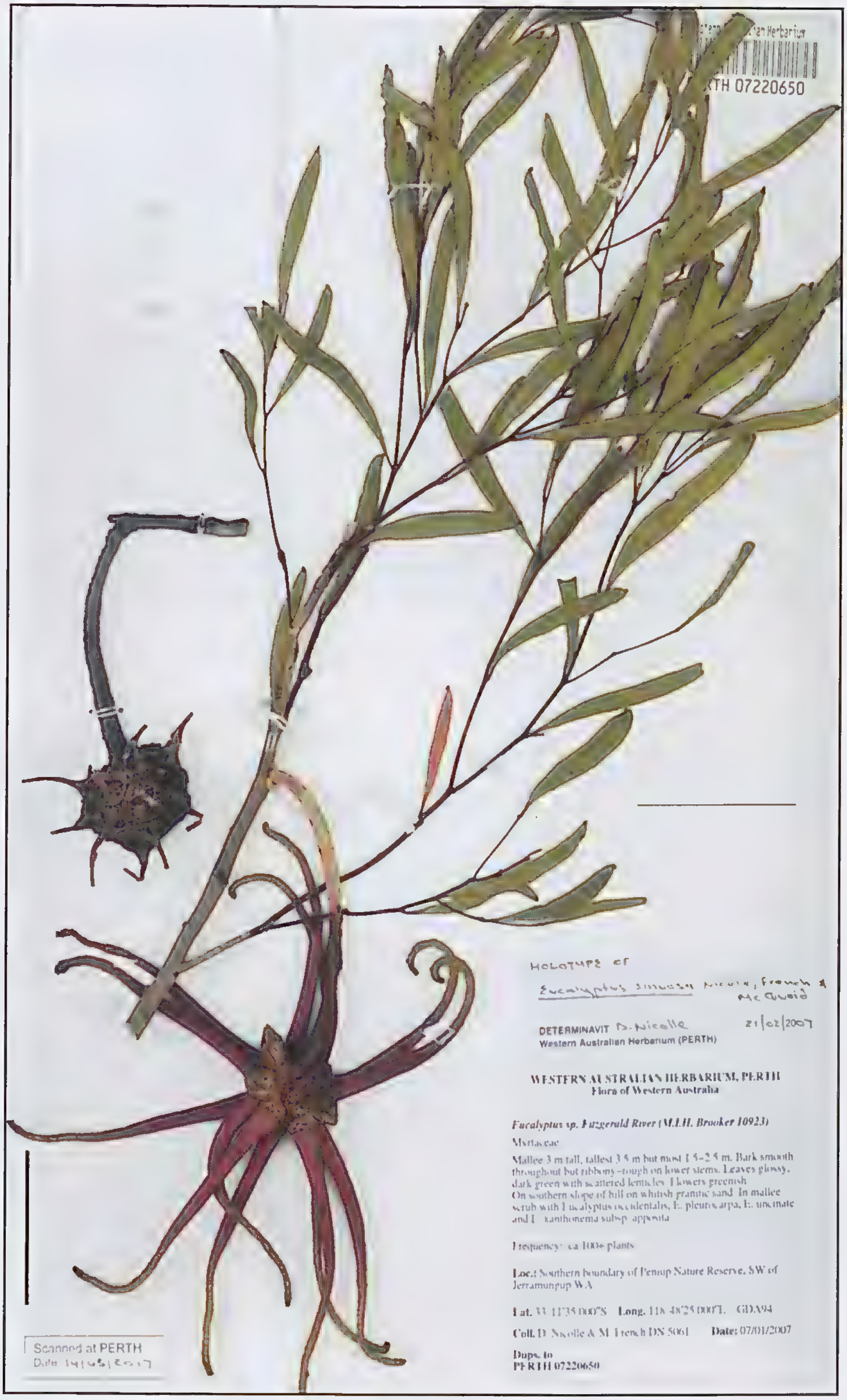

PERTH 07220650
HOLOTYPE OF
Eucalyptus sinuosa Nicolle, French & McQuoid
DETERMINAVIT D. Nicolle 21/02/2007
Western Australian Herbarium (PERTH)
WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia
Eucalyptus sp. Fitzgerald River (M.I.H. Brooker 10923)
Myrtaceae
Mallee 3 m tall, tallest 3.5 m but most 1.5–2.5 m. Bark smooth throughout but ribbony-rough on lower stems. Leaves glossy, dark green with scattered lenticles. Flowers greenish.
On southern slope of hill on whitish granitic sand. In mallee scrub with Eucalyptus occidentalis, E. pleurocarpa, E. uncinata and E. xanthonema subsp. apposita
Frequency: ca 100+ plants
Loc.: Southern boundary of Peniup Nature Reserve, SW of Jerramungup WA
Coll. D. Nicolle & M. French DN 5061 Date: 07/01/2007
Dups. to
PERTH 07220650
Scanned at PERTH
Date 14/05/2007

Figure 9. Holotype of *Eucalyptus sinuosa,* scale = 5 cm.

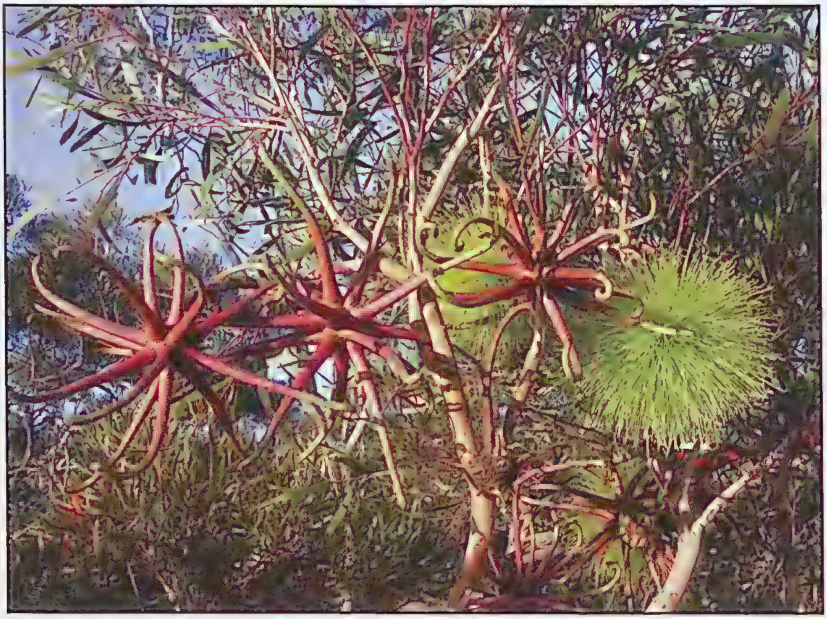


Figure 10. Flowering branch of *Eucalyptus sinuosa* from the type plant.

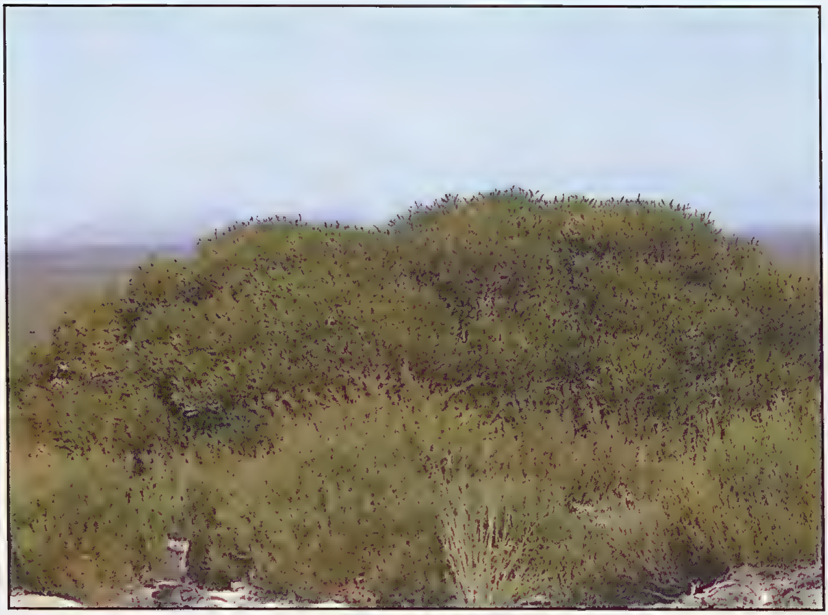


Figure 11. Habitat and habit of *Eucalyptus sinuosa* (*c.* 1 km due south-east of 33° 47' 1" S, 119° 46' 18" E, Fitzgerald River National Park, *D. Nicolle* 5057 & *M.E. French*

5. Eucalyptus lehmannii (Schauer) Benth., *Fl. Austral.* 3: 233 (1867). *Type*: Cape Riche, Western Australia, 19 November 1840, *L. Preiss* 227 (*lecto*: LD *n.v.*, *fide* D.J. Carr & S.G.M. Carr, *Austral. J. Bot.* 28: 531 (1980); *isolecto*: G, MEL).

Symphyomyrtus lehmannii Schauer in J.G.C. Lehmann, *Pl. Preiss*. 1: 127 (1844).

Distinguished within the subseries by its combination of lignotuberous (resprouter) habit; linear to ovate, acuminate adult leaves; long, near-terete to distinctly flattened peduncles; fully fused hypanthia; relatively small buds with narrow, straight and apiculate opercula; and the relatively small fruits.

Mallee to 4(–6) m tall; lignotuber present (resprouter). *Bark* smooth throughout, grey over tan to cream, decorticating in strips and short ribbons. *Seedling leaves* opposite for a few pairs then becoming disjunct, ovate to narrowly ovate, to 60 mm long by 34 mm wide, scabrous, slightly discolorous, dull to slightly glossy, green. *Adult leaves* shortly petiolate; lamina glossy, green to dark green, linear to narrow-lanceolate to elliptic to ovate, apiculate, 40–75 mm long × 8–27 mm wide, reticulation moderate with few to numerous intersectional oil glands; lenticels rarely recorded. *Inflorescences* axillary, up to 21-flowered; peduncles flattened, becoming more terete at fruiting stage, slightly distally broadened, 30–55 mm long, 5–8 mm wide at base. *Flower buds* with hypanthia sessile and fully fused; opercula narrowly cylindrical, straight, 29–45 mm long × 3–10 mm wide at base, apiculate. *Flowers* yellow-green. *Fruits* sessile and fused; infructescences 32–46 mm in diameter (excluding valves; 40–55 mm diameter including valves); individual fruits sessile and fully fused, 10–15 mm wide at rim; disc level to ascending; valves 3, prominently exserted and with persistent style remnants.

Two parapatric subspecies are recognised in the species, differing primarily on adult leaf morphology.

5a. Eucalyptus lehmannii subsp. lehmannii

Adult leaves shortly petiolate; lamina elliptic to ovate, 40–57 mm long × 16–27 mm wide.

Selected specimens examined. (west to east). WESTERN AUSTRALIA: Millars Point Road, 3.9 km S of Bremer Bay Road, 17 Feb. 2000, *M.I.H. Brooker* 13092 (CANB, PERTH); 1 km NW of Mount Melville, near Cape Riche, 14 Jan. 1979, *M.D. Crisp* 5108 (PERTH); 3 km NW Mount Melville, 23 Jan. 1997, *R. Davis* 2270 (PERTH); on rough track 1.6 km N of Cape Riche, 18 Mar. 1997, *R. Davis* 2881 (PERTH); Millars Point Road, 1.1 km N of camp site, 3 Feb. 1998, *R. Davis* 4926 (PERTH); Mount Melville garbage tip, 16.5 km from highway, 12 Nov. 1986, *K. Hill* 2431, *L.A.S. Johnson & D.F. Blaxell* (NSW, PERTH); Warriup, 17 Nov. 1982, *G.J. Keighery* 5802 (PERTH); Mount Melville road from Wellstead, 10 Dec. 1992, *D. Nicolle* 222 (PERTH); between Pallinup Estuary road and Black Head, 27 Jan. 2001, *D. Nicolle* 3752 *& M. French* (CANB, PERTH); Nioka farm, NE of Manypeaks, 27 Jan. 2001, *D. Nicolle* 3755 *& M. French* (CANB, PERTH); remnant vegetation, N area Plantagenet Loc 6499, ITC Cheynes Tree Farm, Cheynes Beach Road, 28 May 2003, *E.M. Sandiford* 765 (PERTH); remnant vegetation Plantagenet Loc 6489/6812, ITC WimbushTree Farm, South Coast Highway, NW of Manypeaks, 29 July 2003, *E.M. Sandiford* 845 (PERTH).

Distribution and habitat. Distributed in coastal and subcoastal areas on the southern coast of Western Australia from near Manypeaks eastwards to Beaufort Inlet (Figure 4). Occurs on undulating topography, in minor creeklines, on slopes and on broad, subdued ridges, in thin sandy to clayey soils, often over laterite. The subspecies occurs as a component of mallee shrubland. Associated eucalypt species include *Eucalyptus cuspidata, E. doratoxylon, E. goniantha* subsp. *notactites, E. marginata* subsp. *marginata* and *E. pleurocarpa.*

Conservation status. Although of much more restricted distribution compared to subsp. *parallela*, the typical subspecies is relatively common and not considered to be under threat. Not recorded from any conservation parks. Conservation vesting would assist in the conservation status of the subspecies.

Notes. *Eucalyptus lehmannii* subsp. *lehmannii* is distinguished from subsp. *parallela* by the shorter and generally broader, consistently elliptic to ovate adult leaves that are less than twice as long as wide.

Eucalyptus lehmannii subsp. *lehmannii* occurs to the south of the more widespread subsp. *parallela*, and while the distributions of the two subspecies are likely to be parapatric, intergrades are not known. Coarser-leaved populations and individuals of *E. lehmannii* from east of the distribution of subsp. *lehmannii* are considered to represent coastal forms of subsp. *parallela* rather than subsp. *lehmannii*, as although the adult leaves of such populations are broader, they are still relatively long and are never consistently elliptic to ovate as consistently the case in subsp. *lehmannii.*

5b. **Eucalyptus lehmannii** subsp. **parallela** D.Nicolle & M.E.French, *subsp. nov.*

A subspecie typica foliis adultis longioribus et angustioribus (plerumque <14 mm latis) differt.

Typus: John Forrest track near No Tree Hill, Western Australia, 33° 46' 57" S, 120° 03' 06" E, 20 January 2001, *D. Nicolle* 3704 *& M. French (holo*: PERTH 05810442; *iso*: CANB).

Eucalyptus lehmannii subsp. Narrow Leaf (D. Nicolle & M. French DN 4806); *Eucalyptus lehmannii* subsp. *linearifolia* D.Nicolle ms; in Council of Heads of Australasian Herbaria, *Australian Plant Census*, http://www.chah.gov.au/apc/index.html [accessed 28 May 2008].

Eucalyptus lehmannii subsp. *modifolia* D. Nicolle ms, in Council of Heads of Australasian Herbaria, *Australian Plant Census*, http://www.chah.gov.au/apc/index.html [accessed 28 May 2008].

Eucalyptus lehmannii subsp. Northern (M. French 425), in Council of Heads of Australasian Herbaria, *Australian Plant Census*, http://www.chah.gov.au/apc/index.html [accessed 28 May 2008].

Distinguished from subsp. *lehmannii* by its longer and generally narrower (generally <14 mm wide), linear to narrow-lanceolate to narrowly elliptic adult leaves, that are at least twice as long as wide.

Adult leaves shortly petiolate; lamina linear to narrow-lanceolate, 55–75 mm long × 8–14 mm wide. (Figure 12)

Selected specimens examined (west to east). WESTERN AUSTRALIA: 1.7 km along track Elverdton –Moir Road, from Hopetoun Road, 30 Jan. 1998, *M. Bennett* 62 (AD, PERTH); Mount Burdett, Summit, 10 Nov. 1981, *M.I.H. Brooker* 7086 (CANB, NSW, PERTH); at the Whalebone Rock, north side of Mount Le Grand, 15 Jan. 1985, *M.I.H. Brooker* 8788 (PERTH); S slope of Ravensthorpe Range, due N of Ravensthorpe, 7 Apr. 1995, *M.I.H. Brooker* 12202 W (AD, CANB, NSW, PERTH); Quiss Road, S of Ranger's House, Fitzgerald National Park Headquarters, 18 Sep. 1999, *M.I.H. Brooker* 13034 (AD, CANB, PERTH); Eyre district; Ravensthorpe Range, Mount Desmond, 11 km SE of Ravensthorpe,

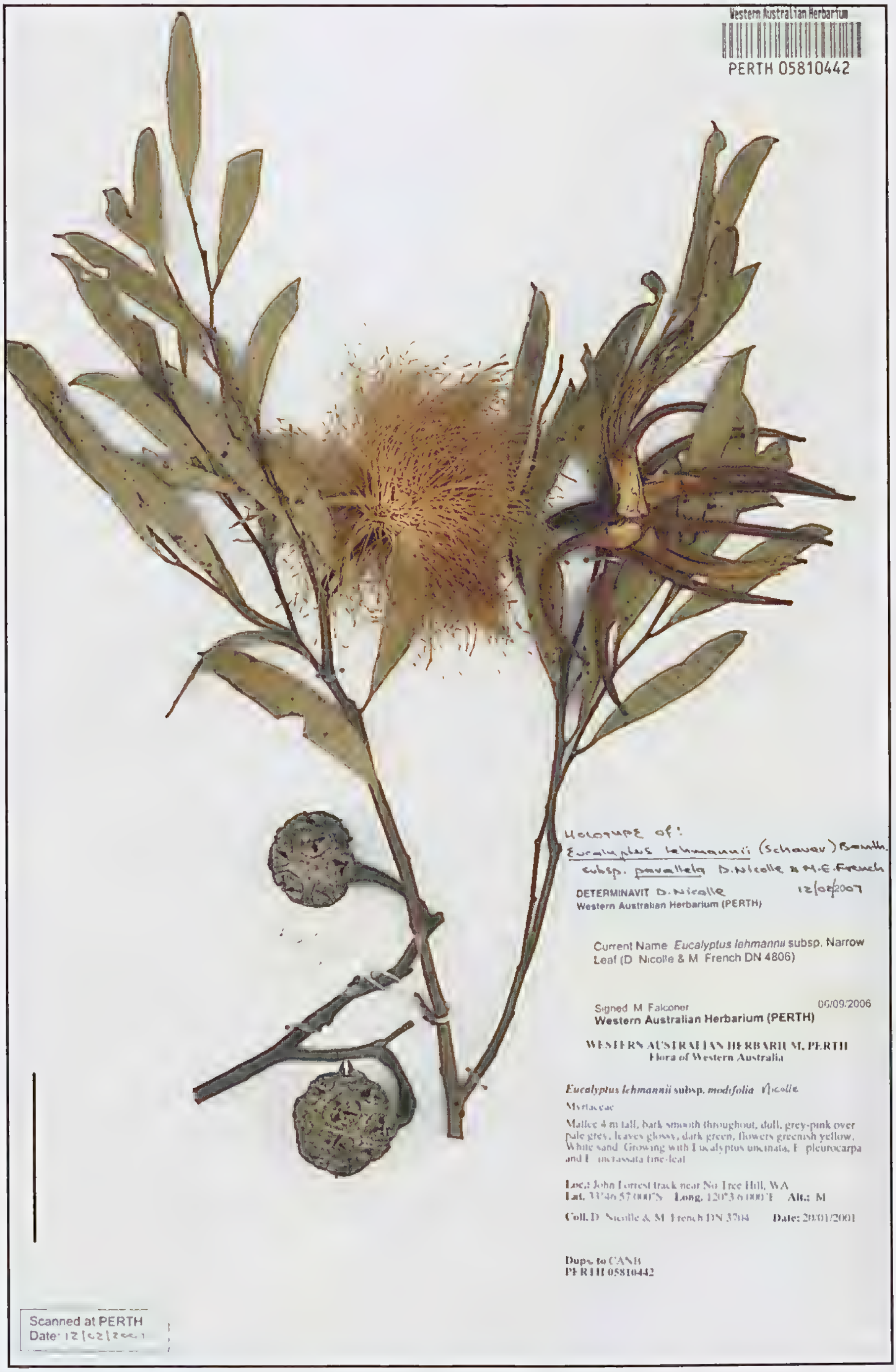

Western Australian Herbarium
PERTH 05810442
Holotype of:
Eucalyptus lehmannii (Schauer) Benth.
subsp. parallela D.Nicolle & M.E.French
DETERMINAVIT D.Nicolle 12/02/2007
Western Australian Herbarium (PERTH)
Current Name Eucalyptus lehmannii subsp. Narrow Leaf (D Nicolle & M French DN 4806)
Signed M Falconer 06/09/2006
Western Australian Herbarium (PERTH)
WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia
Eucalyptus lehmannii subsp. modifolia Nicolle
Myrtaceae
Mallee 4 m tall, bark smooth throughout, dull, grey-pink over pale grey, leaves glossy, dark green, flowers greenish yellow. White sand. Growing with Eucalyptus uncinata, E. pleurocarpa and E. incrassata fine-leaf
Loc.: John Forrest track near No Tree Hill, WA
Lat. 33°46'57.000"S Long. 120°3'6.000"E Alt.: M
Coll. D. Nicolle & M. French DN 3704 Date: 20/01/2001
Dups. to CANB
PERTH 05810442
Scanned at PERTH
Date: 12/02/2007

Figure 12. Holotype of *Eucalyptus lehmannii* subsp. *parallela,* scale = 5 cm..

9 Jan. 1979, *M.D. Crisp* 4970 (PERTH); S of Condingup, very exposed W slope of Mt Belches, 50 m from the summit, 15 Mar. 1998, *M. French* 403 (PERTH); NE of Ravensthorpe Ranges on Nindibillup Road, 16 March 1998, *M.E. French* 425 (PERTH); *c.* 6 km SW of Kundip, S of Ravensthorpe, 23 Nov. 1999, *M.E. French* 1104 (PERTH); No. 62 hill, E of Esperance, 9 Dec. 1960, *A.S. George* 2158 (PERTH); 30 miles W of Ravensthorpe, 13 March 1957, *J.W. Green* 1190 (PERTH); SW side of Howick Hill, just below main area of outcropping granite, 8 Nov. 1983, *L. Haegi* 2608 *& P.S. Short* (PERTH); Reynolds Hill, 8 June 1989, *S.D. Hopper* 7269 (PERTH); S side of hill *c.* 4 km SE of Mount Baring, 21 Nov. 1994, *D. Nicolle* 1096 (CANB, PERTH); north of Mt Trio, Stirling Range National Park, 4 Nov. 2000, *D. Nicolle* 3561 & M. French (CANB, PERTH); near Mt Desmond, S of Ravensthorpe, 300 m west down steep slope, 20 July 2001, *D. Nicolle* 3967 *& M. French* (PERTH); 6.3 km west from Hopetoun road on Road 11, 20 July 2001, *D. Nicolle* 3970 *& M. French* (PERTH); near summit of Mt Barren West, Fitzgerald River National Park, 31 July 2002, *D. Nicolle* 4432 *& M.I.H. Brooker* (PERTH); granite dome *c.* 500 m SE of Mt Arid, Cape Arid National Park, 4 Mar. 2003, *D. Nicolle* 4575 *& M. French* (PERTH); south-western boundary of Corackerup Nature Reserve on Boxwood Hill–Ongerup Rd, 23 Sep. 2004, *D. Nicolle* 4802 *& M. French* (PERTH); east of Hamilla Hill, 24 Sep. 2004, *D. Nicolle* 4806 *& M. French* (PERTH).

Distribution and habitat. By far the most widespread taxon in the subseries, occurring from the Stirling Range eastwards to the Ravensthorpe Range and as very scattered populations east of Esperance from the Wittenoom Hills and Cape Le Grand eastwards to Cape Arid National Park (Figure 4). The apparent disjunction in the distribution of this subspecies, of at least 150 km between populations in the Ravensthorpe area and scattered populations to the east and north-east of Esperance, is possibly due to the generally level topography in this region, resulting in a lack of suitable habitats for the species. The subspecies grows in undulating topography in a variety of sites from subdued valleys to hillslopes and ridges. Restricted to the fringes of granite hills and outcrops east of Esperance, and also common on granite or spongolite soils elsewhere to the west. Associated with a wide variety of coastal eucalypt species, including *Eucalyptus clivicola, E. cooperiana, E. decipiens* subsp. *adesmophloia, E. decurva, E. doratoxylon, E. extrica, E. falcata, E. hebetifolia, E. incrassata, E. pachyloma, E. phaenophylla, E. pleurocarpa, E. preissiana* subsp. *preissiana, E. redunca, E. sporadica, E. thamnoides, E. tetraptera, E. uncinata* and *E. utilis*.

Conservations status. This subspecies is widespread and locally common and is not considered to be at risk. Well represented in conserved areas and recorded from Cape Arid, Cape Le Grand, Fitzgerald River and Stirling Range National Parks and Corackerup and Wittenoom Hills Nature Reserves.

Etymology. From the Latin *parallelus* (side by side equidistantly), referring to the narrower and more parallel-sided adult leaves in comparison to the elliptic to ovate adult leaves of the typical subspecies.

Notes. Eucalyptus lehmannii subsp. *parallela* is distinguished from subsp. *lehmannii* by the longer and generally narrower, linear to narrow-lanceolate to narrowly elliptic adult leaves, that are at least twice as long as wide.

Eucalyptus lehmannii subsp. *parallela* is the widespread variant of the species, and occurs to the north and east of subsp. *lehmannii*. The distributions of the two subspecies are likely to be parapatric, however intergrades are not known.

Populations of *E. lehmannii* subsp. *parallela* from east of Esperance, particularly coastal populations (e.g. Cape Le Grand and Mt Howick) are often coarser-leaved than populations of the subspecies from Ravensthorpe westwards. Similarly coarse-leaved populations of the subspecies are known from some sites west of Ravensthorpe, notably where growing on the slopes and summit of West Mount Barren. Such coarser-leaved populations are likely to be a result of local site adaptation (particularly coastal influences) and are not considered worthy of taxonomic recognition, at least pending further field study. The adult leaves of such coarse-leaved populations of subsp. *parallela* are still relatively long and are never consistently elliptic to ovate in shape as in subsp. *lehmannii*.

Eucalyptus lehmannii subsp. *parallela* occasionally hybridises with *E. sporadica* Brooker & Hopper, with the type of *E. bennettiae* D.Carr & S.Carr representing one such hybrid. The type plant of *E. bennettiae*, from Mt Desmond near Ravensthorpe, occurs in dense mallee shrubland with both *E. lehmannii* subsp. *parallela* and *E. sporadica* common at the site. Individuals with morphology consistent with *E. bennettiae* at Mt Desmond have been recorded from a number of scattered localities to the south-west, including on Road 11 (west of Kundip) and near Quoin Head and at Twin Bays in Fitzgerald River National Park.

Progeny grown at Currency Creek Arboretum (Nicolle 2003) from seed taken from the type individual of *E. bennettiae* segregate between the putative parent species in seedling morphology (*E. lehmannii* has broader, scabrid seedling leaves; *E. sporadica* has narrower, glabrous seedling leaves). Adult morphology of the same progeny is also variable between individuals, though more intermediate between the parental species (i.e. more *E. bennettiae*-like rather than segregating towards the typical adult morphology of *E. lehmannii* and *E. sporadica).* Molecular studies (M. Byrne, DEC Science Division, unpublished data) of *E. bennettiae* from the Mt Desmond and Road 11 sites indicate that at each locality the population of *E. bennettiae* consists of a single genetic entity (genet), and shares all molecular markers with the surrounding *E. lehmannii* and *E. sporadica* populations (i.e. having no unique molecular markers).

A single putative hybrid individual of *Eucalyptus lehmannii* subsp. *parallela* × *E. megacornuta* C.A.Gardner also occurs at the type site of *E. bennettiae.* The individual displays morphological characteristics intermediate between the two putative parental taxa, and progeny grown from the putative hybrid individual (Currency Creek Arboretum; Nicolle 2003) display segregating seedling and adult morphology between the two putative parental taxa.

6. **Eucalyptus retusa** D.Nicolle, M.E.French & McQuoid, *sp. nov.*

Inter species subseriei *Conjunctarum* Brooker distinguenda habitu pluricauli ('mallee') et praesentia lignotuberis, foliis adultis obovatis et saepe retusis, pedunculis longis teretisque, hypanthis partim connatis, alabastris parvis, operculis angustis erectisque, et apice minute bulboso, fructibus parvis.

Typus: Hood Point [precise locality withheld for conservation reasons], 23 September 2004, *D. Nicolle* 4801 *& M. French* (*holo*: PERTH 06877109; *iso*: AD, CANB).

Eucalyptus sp. Bremer Bay (L.M. Sandiford. PERTH 01137484); *Eucalyptus retusa* D.Nicolle ms; *Eucalyptus jinungurdu* McQuoid & Hopper ms, in Council of Heads of Australasian Herbaria, *Australian Plant Census*, http://www.chah.gov.au/apc/index.html [accessed 28 May 2008].

Distinguished in the subseries by its combination of lignotuberous (resprouter) mallee habit; obovate, often retuse adult leaves; long, terete peduncles; partially fused hypanthia; small buds with narrow, straight and apiculate to bulbous opercula; and small fruits.

Mallee 0.5–4 m tall; lignotuber present. *Bark* smooth throughout, pale grey-tan over cream. *Seedling leaves* opposite for one to three pairs then becoming disjunct, ovate to orbicular-ovate, often becoming slightly retuse, to 50 mm long by 40 mm wide, scabrous, slightly discolorous, dull, pale green. *Adult leaves* with petiole tapering to lamina; lamina glossy, green, obovate to spathulate, often retuse, 30–55 mm long × 14–20 mm wide. *Inflorescences* axillary, unbranched, partially fused (lower half only of hypanthia fused), 13–19-flowered; peduncles terete, distally thickened, 20–35 mm long. *Flower buds* fused; operculum 40–42 mm long, 4–6 mm wide at base, straight to slightly curved, apiculate or slightly swollen at tip. *Flowers* yellow-green. *Fruits* fused for basal half only, infructescences 30 mm in diameter (including valves); individual fruits obconical, 7–10.5 mm wide; disc level to ascending; valves 3 (rarely 4), rim level to strongly exserted. (Figures 13, 14)

Selected specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 9 March 1988, *M.I.H. Brooker* 9920 (AD, CANB, PERTH); 21 Jan. 2005, *J.A. Cochrane & S. Comer* 140 (PERTH); Feb. 1989, *L.M. Sandiford s.n.* (PERTH).

Distribution and habitat. Known from a single population at Hood Point, east of Bremer Bay on the south coast of Western Australia (Figure 6), where the species is common on a rocky headland in low scrubland. Associated species include *E. cuspidata* and *Melaleuca nesophila*. A second population may occur at Cape Knob, south-west of Bremer Bay and approximately 35 km to the south-west of the known population at Point Hood; however this population requires further study to ascertain its identity and relationship to the type population.

Conservation status. The single known population consists occurs over several hectares on a recreation reserve vested in the Shire of Jerramungup. The unconfirmed Cape Knob population is also on a recreation reserve vested in the Shire of Jerramungup. Recommended listing as Priority One under DEC Conservation Codes for Western Australian Flora (K. Atkins, pers. com.).

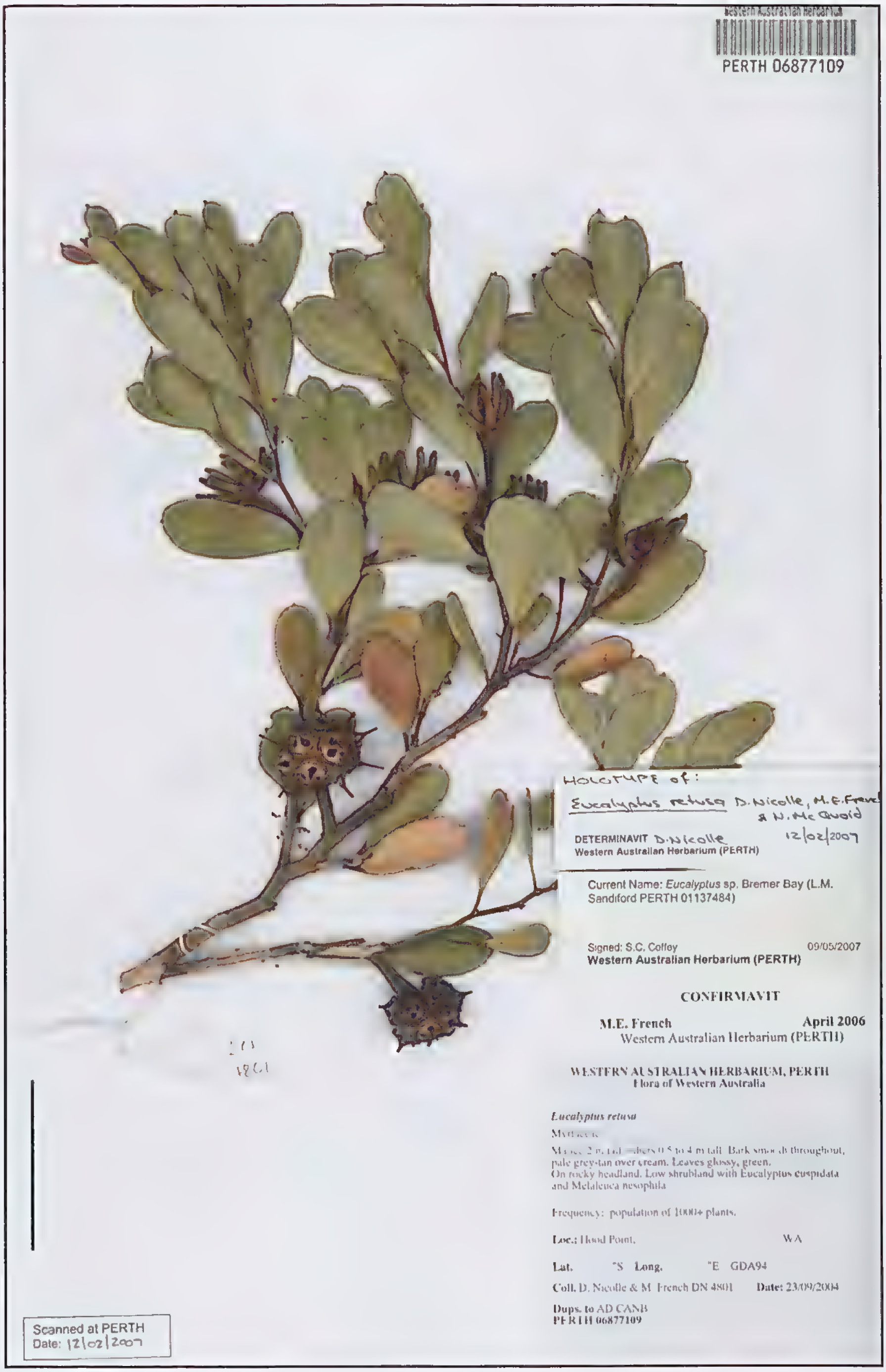
Etymology. From the Latin *retusus* (blunted, rounded, notched at the apex), referring to the retuse adult leaves which distinguish the species from other taxa in the subseries.

Notes. *Eucalyptus retusa* is distinct and unique in the series due to its variably notched (retuse) adult leaves. The species is also distinctive within *E.* subser. *Conjunctae* in its partly fused hypanthia in the bud and fruit inflorescences, perhaps as a result of past or current hybridisation with *E. cornuta* Labill. (see below). All other taxa of *E.* subser. *Conjunctae* have hypanthia fused for their entirety.

The small buds and fruits and less fused hypanthia of *E. retusa* in comparison to other taxa of *E.* subser. *Conjunctae* may be a result of some past and/or current genetic influence from *E. cornuta*, which occurs nearby at Gordon Inlet. Seedlings of *E. retusa* grown from the type population show some morphological segregation in the shape of the seedling leaves (particularly in the degree of emargination), which also suggests introgression from *E. cornuta*. Nonetheless, the populations at Hood Point are distinctive and largely uniform and we are satisfied that species recognition is justified. Further study of the evolutionary origin and genetic variability of *E. retusa* is warranted.

Hybrids between *E. retusa* and *E. cuspidata* occur at Hood Point and are similar in morphology to *E.* × *missilis* Brooker & Hopper (= *E. cornuta* × *E. cuspidata* Turcz.).

The anomalous population from Cape Knob has narrower adult leaves than typical *E. retusa*, and this population requires further study to ascertain its identity.



Western Australian Herbarium
PERTH 06877109

HOLOTYPE of:
Eucalyptus retusa D. Nicolle, M.E. French & N. McQuoid
DETERMINAVIT D. Nicolle 12/02/2007
Western Australian Herbarium (PERTH)

Current Name: *Eucalyptus* sp. Bremer Bay (L.M. Sandiford PERTH 01137484)

Signed: S.C. Coffey 09/05/2007
Western Australian Herbarium (PERTH)

CONFIRMAVIT

M.E. French **April 2006**
Western Australian Herbarium (PERTH)

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Eucalyptus retusa

Myrtaceae

Mallee 2 m tall, others 0.5 to 4 m tall. Bark smooth throughout, pale grey-tan over cream. Leaves glossy, green.
On rocky headland. Low shrubland with Eucalyptus cuspidata and Melaleuca nesophila

Frequency: population of 1000+ plants.

Loc.: Hood Point. WA

Lat. °S **Long.** °E GDA94

Coll. D. Nicolle & M. French DN 4801 **Date:** 23/09/2004

Dups. to AD CANB
PERTH 06877109

Scanned at PERTH
Date: 12/02/2007

Figure 13. Holotype of *Eucalyptus retusa*, scale = 5 cm.

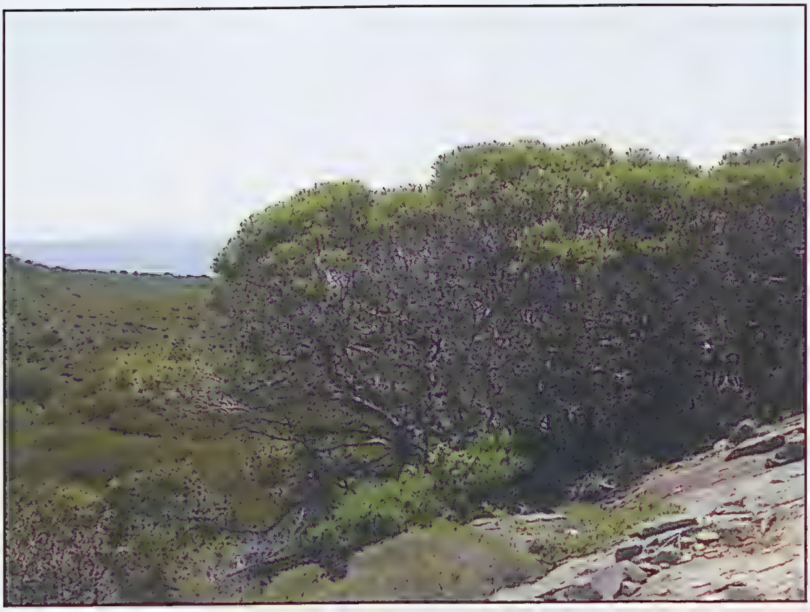


Figure 14. Habitat and habit of *Eucalyptus retusa* (Point Hood, Fitzgerald River National Park, 34° 23' S, 119° 34' E, *D. Nicolle* 4801 *& M. French*).

Natural hybrids involving *Eucalyptus* subser. *Conjunctae*

Eucalyptus conferruminata subsp. **recherche** × **E. incrassata**

Selected specimens examined. WESTERN AUSTRALIA: Lower coastal slopes at the W windward side of Woody Island, SE of Esperance, 24 Feb. 2001, *M.E. French* 1265 (PERTH); West side of Woody Island, Recherche Archipelago, Western Australia, 10 March 2003, *D. Nicolle* 4610 *& M. French* (PERTH).

Eucalyptus conferruminata subsp. **conferruminata** × **E. cornuta**

Selected specimens examined. WESTERN AUSTRALIA: between CSIRO hut and Robinson Bay, Noisy Scrub-bird Sanctuary, Two Peoples Bay, E of Albany, 25 Jan. 1973, *N.T. Burbridge* 8133 (CANB, PERTH); Two Peoples Bay Nature Reserve, at old Jeemaluk hut site, 10 May 2007, *N.K. McQuoid* 617 (PERTH); eastern slopes of Mt Gardner, 10 May 2007, *N.K. McQuoid* 618, 619, 620 (all at PERTH).

Eucalyptus cornuta × **E. lehmannii** subsp. **lehmannii**

Selected specimens examined. WESTERN AUSTRALIA: remnant vegetation Plantagenet Loc 6489/6812 ITC Wimbush Tree Farm, South Coast Highway, NW of Manypeaks, 19 Aug. 2003, *E.M. Sandiford* 858 (PERTH).

Eucalyptus cornuta × **E. lehmannii** subsp. **parallela**

Selected specimens examined. WESTERN AUSTRALIA: SW of Orleans Bay Caravan Park, E slope of Mount Belches, 15 Mar. 1998, *M. French* 404 (PERTH); Stirling Range National Park, 8 June 1972, *A.S. Weston* 7749 (PERTH).

Eucalyptus cuspidata × **E. retusa**

Selected specimens examined. WESTERN AUSTRALIA: Hood Point, 9 Mar. 1988, *M.I.H. Brooker* 9919 (CANB, PERTH).

Eucalyptus lehmannii subsp. **parallela** × **E. megacornuta**

Selected specimens examined. WESTERN AUSTRALIA: 300 m west down steep slope from below coordinates; near Mt Desmond, S of Ravensthorpe, 33° 36' 50" S, 120° 09' 05" E, 5 Nov. 2000, *D. Nicolle* 3577 *& M. French* (CANB, PERTH).

Eucalyptus lehmannii subsp. **parallela** × **E. sporadica**

Typus: NW slope of Mt Desmond, 33° 37' S, 127° 07' E, Western Australia., 15 August 1979, *D.J. Carr & S.G.M. Carr* 2304f (*holo*: PERTH 01174606, 01174614; *iso*: PERTH 05959578, 01174622).

Eucalyptus bennettiae D.Carr & S.Carr, *Austral. J. Bot.* 28: 541 (1980).

See *Notes* under *E. lehmannii* subsp. *parallela* for discussion on the hybrid origin of *E. bennettiae.*

Selected specimens examined. WESTERN AUSTRALIA: Ravensthorpe Range, Aug. 1979, *E.M. Bennett s.n.* (PERTH); Ravensthorpe Range, NW of Mount Desmond, 13 Nov. 1981, *M.I.H. Brooker* 7142; 7144 (PERTH); Mount Desmond, W side, *s. dat., R.J. Hnatiuk* 790026 (PERTH); 2.5 km NE of Quoin Head; on Whalebone track, Fitzgerald River National Park, 15 Dec. 1988, *N. McQuoid s.n.* (PERTH); Twin Bays, Fitzgerald River National Park, 10 Jan. 1994, *N. McQuoid* 413 (PERTH); 300 m west down steep slope from below coordinates; near Mt Desmond, S of Ravensthorpe, 5 Nov. 2000, *D. Nicolle* 3576 *& M. French* (PERTH); 6.3 km down track from Hopetoun to Ravensthorpe road opposite Jerdacuttup Road junction, 5 Nov. 2000, *D. Nicolle* 3582 *& M. French* (AD, CANB, PERTH); 300 m west down steep slope from below coordinates; near Mt Desmond, S of Ravensthorpe, 33° 36' 50" S, 120° 09' 05" E, 20 July 2001, *D. Nicolle* 3964; 3965; 3966 *& M. French* (PERTH); 6.3 km west from Hopetoun road on Road 11, 20 July 2001, *D. Nicolle* 3969 *& M. French* (PERTH).

Eucalyptus lehmannii subsp. **parallela** × **E. tetraptera** Turcz.

Selected specimens examined. WESTERN AUSTRALIA: No specimens collected, but observed by one of us (NMQ) on the southern slopes of Thumb Peak and north of Mt Drummond in Fitzgerald River National Park, and on Mt Burdett, north-east of Esperance.

Eucalyptus macrandra F.Muell. ex Benth. × **E. sinuosa**

Selected specimens examined. WESTERN AUSTRALIA: 3 km E from Drummond Track on the southern of parallel firebreaks, 18 Jan. 1989, *A. Napier & D. Goble-Garratt* 365 (PERTH).

Acknowledgements

We are grateful to staff at the Western Australian Herbarium and the Biodiversity Conservation Initiative team in Perth for their assistance in preparing this paper. Ryonen Butcher (BCI) has been particularly helpful in providing images of type specimens. We thank Sarah Comer of the Department of Environment and Conservation in Albany for her assistance with *E. conferruminata* and *E. retusa*. The senior author thanks Ian Brooker for ongoing discussion regarding eucalypt taxonomy as well as for checking the Latin diagnoses and suggesting the scientific epithet for *E. retusa*.

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Nuytsia 18: 223–234 (2008)

Recognition of new taxa in *Grevillea* (Proteaceae: Grevilleoideae) from south-west Western Australia

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Abstract

Olde, P.M. & Marriott, N.R. Recognition of new taxa in *Grevillea* (Proteaceae: Grevilleoideae) from south-west Western Australia. *Nuytsia* 18: 223–234 (2008). In this paper we recognise one new *Grevillea* species, *Grevillea hislopii* P.M.Olde & N.R.Marriott and two new subspecies, *Grevillea althoferorum* P.M.Olde & N.R.Marriott subsp. *fragilis* P.M.Olde & N.R.Marriott and *Grevillea bracteosa* C.F.Meisn. subsp. *howatharra* P.M.Olde & N.R.Marriott. All taxa occur in south-west Western Australia. Morphological analysis suggests that the taxa are not closely related. Interspecific and intraspecific keys are provided and affinities are discussed where relevant. Some of the taxa have a conservation priority and Conservation Codes are provided in all cases.

Introduction

Descriptions of three new taxa in the genus *Grevillea* R.Br. are formally presented. Two taxa, *G. hislopii* and *G. althoferorum* subsp. *fragilis* P.M.Olde & N.R.Marriott, were discovered after completion of three recent revisions of the genus (McGillivray & Makinson 1993; Olde & Marriott 1994a, 1994b, 1994c, 1995a, 1995b; Makinson 2000). Olde and Marriott (1995a: 70) informally recognised a 'small-conflorescence form' in *Grevillea bracteosa Meisn.*which has been included in subsp. *bracteosa* in this treatment. The descriptions closely follow the format and terminology used by D.J. McGillivray and Makinson (1993) though some modifications and changes have been incorporated, following Hewson (1988) and Hickey (1973). Methods of working, additional characters and clarifications of morphological terminology have been outlined in Olde and Marriott (1993a, 1993b, 1994a, 1994b, 1994c, 1995a, 1995b, 2002). Special mention must be made here of the contribution of Mr Fred and Mrs Jean Hort whose dedicated voluntary work has resulted in the discovery of all populations of *G. hislopii* and in the discovery of new large populations of *Grevillea bracteosa* subsp. *bracteosa*. All taxa have been studied in the field. Conservation Codes are those used by the Western Australian Department of Environment and Conservation (DEC).

Taxonomy

1. **Grevillea hislopii** P.M.Olde & N.R.Marriott, *sp. nov.*

Simillima *Grevilleae occidentali* R.Br. sed foliorum pagina inferiore puberulosa, mucrone ligno-brunneo, conflorescentiis minoribus, floribus ad axem versatis, pedicellis brevioribus (usque ad 2.5 mm longum) differt.

Typus: Yarra Road, Western Australia [precise locality withheld for conservation reasons], 5 September 2002, *P.M. Olde* 02/80 *& N.R. Marriott* (*holo*: PERTH 07692412; *iso*: K, MEL, NSW, NY).

Seedling (1 specimen examined) based on *P.M. Olde* 02/80a *& N.R. Marriott* (NSW). *Cotyledons* 7 mm long, 2.5 mm wide, glabrous, longitudinally wrinkled. *Hypocotyl* 0.5 mm thick, subterete, with moderately dense mixed indumentum of spreading biramous hairs with acute apices and scale-like trichomes with blunt apices. *Seedling leaves* sessile, alternate, simple, entire, obovate, flat; first leaf 1.7 mm long, 5 mm wide, adaxial surface concave, sparsely tomentose, longitudinally wrinkled with prominent reticulum, the midvein obscure; abaxial surface tuberculate with occasional raised simple hairs or minute scales, the midvein protuberant, the reticulum prominent, the margin flat, slightly thickened, partially ciliate; mucro reddish; second leaf similar; third leaf similar but with a moderately dense spreading indumentum more dense on the adaxial surface; fourth leaf with a moderately dense spreading subvillous indumentum on the adaxial surface, the midvein evident; abaxial surface with a dense indumentum of curled hairs intermixed with erect, long straight hairs, the midvein glabrous, evident but more distinct than on the adaxial surface. *Mature plants* moderately dense, rounded, single-stemmed *shrubs* 0.4–1.4 m high, 0.4–1.2 m wide. *Branchlets* angular, glabrous and granulate to scabrous, or with a sparse to dense indumentum of long spreading hairs. *Juvenile leaves* white-villous. *Mature leaves* 1–3 cm long, 1.2–6 mm wide, patent to ascending, sessile to shortly petiolate, simple, linear to very narrowly elliptical; petioles 0–1 mm long, sparsely villous; leaf base linear to narrowly cuneate or attenuate; apex acute or shortly acuminate, the mucro up to 1.5 mm long, pale brown with creamy-yellow base, aristate to blunt, usually straight, slightly brittle, scarcely to non-pungent; margin smoothly recurved to revolute, sometimes enclosing the undersurface on narrower leaves; adaxial (upper) surface granular to scabrid, the asperities sometimes topped by hair bases or by straight or curled biramous trichomes; abaxial (lower) surface with a dense two-state indumentum of mainly short, somewhat appressed, curled or twisted hairs, intermixed with longer, straight, spreading or appressed hairs, these often confined to the midvein which may also be glabrous or almost so; venation of the adaxial surface obscure, on the abaxial surface the midvein protuberant at the base, prominent in the proximal half becoming obscure distally; texture chartaceous to firmly so. *Conflorescences* 0.5–0.8 cm long, *c.* 0.5 cm wide, terminal, subterminal on short side branches or axillary, often crowded in the upper axils, erect, sessile to shortly pedunculate, simple, subglobose, dense, basipetal; peduncles 0–1.5 mm long, white-villous; rachises 0.5–1 mm long, villous; floral bracts 2–2.5 mm long, 0.7–1.2 mm wide, ovate-acuminate to obovate or sometimes sub-spathulate, apex acute, sparsely villous adaxially, glabrous on the abaxial surface, variably caducous, often some persisting beyond anthesis. *Flower colour* perianth whitish-grey, limb grey-black and slightly rusty; style white with pink surface visible through the indumentum, pollen-presenter green. *Flowers* adaxially oriented, acroscopic; pedicels 1.5–2.5 mm long, villous; torus transverse to slightly oblique to *c.* 10°, 0.6 mm across; nectary 0.3–0.6 mm high, 0.2–0.3 mm thick, superposed on the torus but usually inconspicuous through tight enclosure by the perianth base, lunate to 2/3 annular, margin bi- to tri-dentate or crenate; perianth 2.5–3 mm long, 0.8–1 mm wide, persistent, coherent except along the dorsal side, rolling down and spreading out to form an oval, almost flat platform below the style, villous abaxially, glabrous on the adaxial surface from the base for 1.2 mm, papillose to *c.* halfway grading to subsericeous from about the middle to the limb; basal portion of the perianth coherent after anthesis and closely appressed to the level of the nectary; limb 1 mm long, 1.2 mm across, ovoid, coherent after anthesis; pistil 6 mm long, villous; stipe 0.6 mm long, glabrous; ovary 0.6 mm long, obliquely ellipsoid, densely villous; style angularly infracted, exserted beyond the dorsal outline of the perianth prior to anthesis; pollen-presenter 0.8 mm long, 0.8 mm wide, lateral, round, almost flat; margin 0.1 mm thick, slightly thickened, undulate; stigma central, surmounting a boss-like rise. *Fruits* (*F. Hort* 2752) 7.5–12(–13) mm long, 6.5–7 mm wide, 3.5–4 mm thick; erect on decurved pedicels, narrowly and obliquely ovoid with apex recurved; styles persistent; surface openly villous, long and short hairs intermixed, the hairs evanescent, the revealed surface faintly rugulose and with 5–7 prominent dorsal ribs; pericarp *c.* 0.2 mm across at the suture; texture crustaceous. *Seeds* (*F. Hort* 2608; immature) oblong-obovoid, 5 mm long, 1 mm wide, narrowly marginate along the anterior edge, forming a wrinkled triangular extension *c.* 0.5 mm long and of waxy texture; pulvinus not evident; outer face convex, smooth; inner face flat. (Figure 1)

Selected specimens (27 examined). WESTERN AUSTRALIA: [localities withheld] 5 Oct. 1999, *F. Hort* 646 (CANB, G, P, PERTH 05408326); 11 Sep. 2000, *F. Hort* 1129 (CANB, MEL, PERTH 05678374); 11 Sep. 2000, *F. Hort* 1130 (AD, NSW, PERTH 05694833); 5 Sep. 2005, *F. Hort* 2608 (PERTH 07185499); 14 Dec. 2005, *F. Hort* 2752 & *A. Lowrie* (NSW, PERTH 07247125); 5 Sep. 2002, *P.M. Olde* 02/74 & *N.R. Marriott* (AD, BRI, CANB, NSW, US).

Distribution. Western Australia, in State Forests west of York (Figure 2).

Habitat and ecology. Grows in granite hills in open sunny positions above drainage and creek lines. Soils are clay loam with laterite. Associated species vary at each site but consist generally of species associated with wandoo open woodland. Associated species recorded (*F. Hort* 2608) at one site included *Allocasuarina huegeliana, Acacia pulchella, Trymalium ledifolium, Banksia dallanneyi and Cryptandra arbutiflora.*

Flowering period. Spring.

Fruiting period. Not known, probably late October.

Conservation status. Known from four populations, at three of which it is abundant. We do not consider that there is an urgent conservation imperative for this species. Recently listed as Priority Two under DEC Conservation Codes for Western Australian Flora.

Etymology. Named in honour of Michael Clyde Hislop (1955–), who, as identifications botanist at PERTH, drew our attention to the first collection of this species.

Affinities. Grevillea hislopii is included in Group 22 *sensu* Olde and Marriott (1994c: 10). All species of this group were included in the *Buxifolia* Group *sensu* Makinson (2000). *Grevillea hislopii* is most closely related to *G. occidentalis* R.Br. (Brown 1810: 173) which differs in having an appressed indumentum of fine, straight, mutually aligned hairs on the leaf abaxial surface, the mucro black, the conflorescences larger (1.5 cm long, *c.* 3 cm wide), the flowers abaxially oriented, pedicels longer (3.5–10 mm long) and the pollen-presenter oblique at *c.* 50°. *Grevillea hislopii* is also related to *G. umbellulata* Meisn. which has an allopatric but overlapping distribution. *Grevillea umbellulata* differs in having sericeous branchlets, the adaxial surface of leaves smooth, conflorescences with flowers loose (i.e. not in a tight, dense head), narrower floral bracts 0.2–0.7 mm wide, pedicels 3–7 mm long.

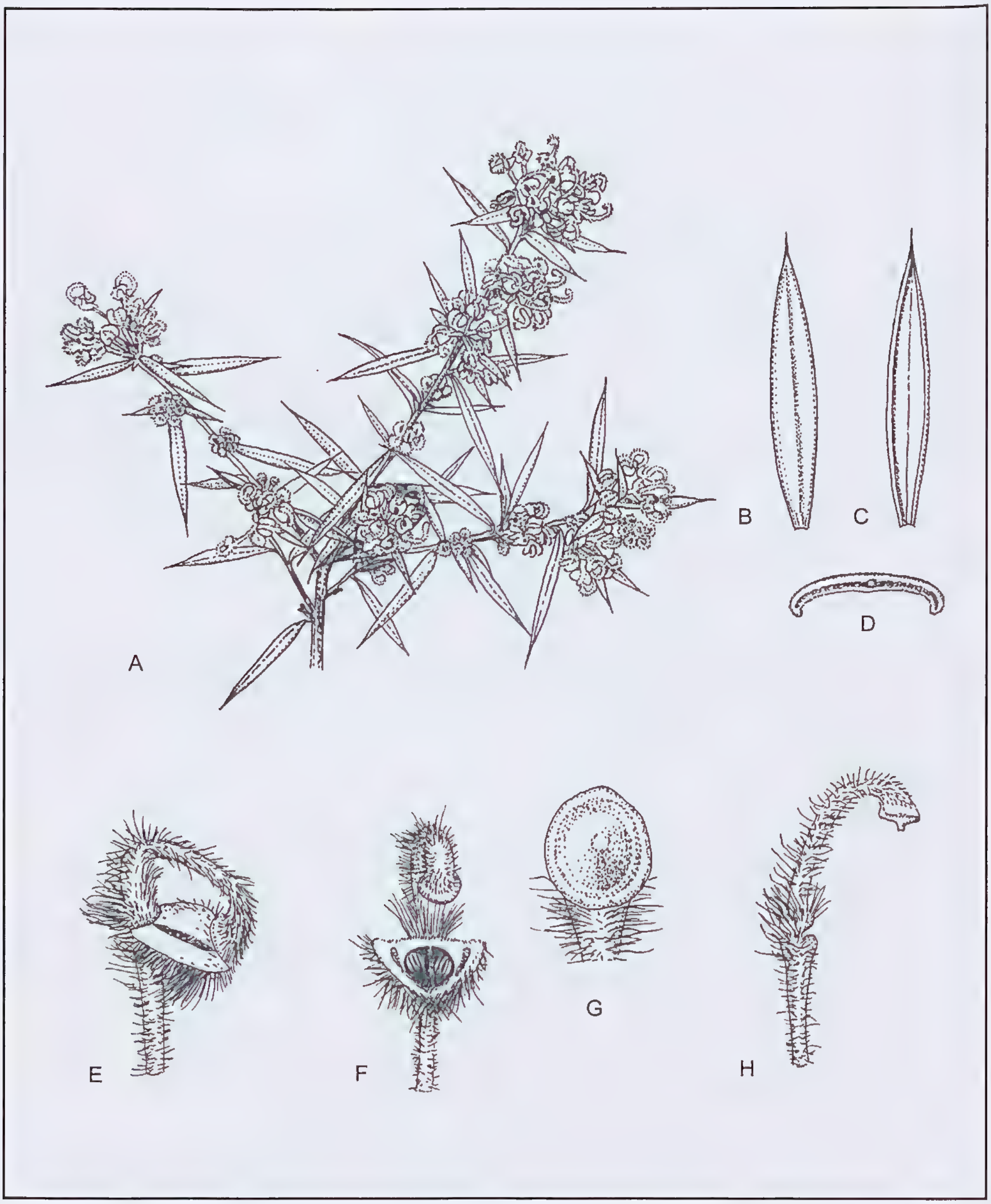

Figure 1. *Grevillea hislopii*. A – habit of plant (×1); B – adaxial surface of leaf (×2); C – abaxial surface of leaf (×2); D – leaf in cross-section (× 2); E – perianth and pistil just prior to anthesis (×4); F – perianth and pistil post-anthesis (× 4); G – pollen-presenter (×12); H – pistil (×4).

Revised key to Group 22 *sensu* Olde and Marriott (1994c)

1. Style-end red, yellow or orange; style-end either glabrous or papillose or if hairy, then with a glabrous or papillose appendage

2. Stylar appendage incurled; stigma extending inconspicuously from the pollen-presenter ≤ 0.2 mm; pollen-presenter concurrent with the ventral side of the style-end

3. Apex of stylar appendage papillose; leaf upper surface scabrous; base of pollen presenter projecting from line of style; style strongly incurved .... **G. scabra**

3: Apex of stylar appendage glabrous; leaf upper surface usually smooth; base of pollen presenter concurrent with style; style ± straight .... **G. candolleana**

2: Style-end either lacking an appendage or if present then the appendage not incurled; stigma conspicuous, extending 0.3–0.4 mm from face of pollen presenter; pollen-presenter raised or protuberant from the ventral side of the style-end

4. Style-end glabrous and smooth; leaves not fasciculate .... **G. pilulifera**

4: Style-end papillose or with a dense indumentum of short erect trichomes; leaves fasciculate or not

5. Distal edge of pollen-presenter level with or exceeding apex of style-end; dorsal tepals lacking a small auricular lobe on posterior edge just below the limb cup; leaf margins angularly refracted about the intramarginal vein .... **G. uncinulata**

5: Distal edge of pollen-presenter overtopped by a short beaked extension of the style-end; dorsal tepals with a small auricular lobe on posterior edge just below the limb cup; leaf margins smoothly recurved to revolute .... **G. florida**

1: Style-end grey or pinkish or purplish grey, hairy; appendage hairy if present

6. Leaf adaxial (upper) surface smooth .... **G. umbellulata**

6: Leaf adaxial surface granular to scabrous

7. Flowers abaxially oriented; pedicels with rusty hairs or not

8. Leaf abaxial (lower) surface sericeous, all hairs ± of equal length

9. Mature fruits 8–12 mm long; perianth mostly greyish-white with brown hairs restricted to the limb; pollen-presenter broad-elliptic to round .... **G. occidentalis**

9: Mature fruits 14–25 mm long; perianth mostly rusty outside; pollen-presenter narrow-elliptic .... **G. sphacelata**

8: Leaf abaxial surface either not sericeous or sericeous but with both short and long hairs intermixed

10. Leaf abaxial surface with a one-state villous indumentum of long, robustly descending dark hairs; stylar appendage antrorse < 1 mm long .... **G. phylicoides**

10: Leaf abaxial surface two-state, usually with a number of short and long hairs intermixed; appendage 0.7–2.5 mm long, erect to retrorse .... **G. buxifolia** *sens. lat.*

7: Flowers adaxially oriented; pedicels lacking rusty hairs

11. Pedicels < 3 mm long; pistils < 7 mm long; pollen-presenter distinctly rimmed; leaf mucro aristate, finely pointed .... **G. hislopii**

11: Pedicels 5–9 mm long; pistils 9–12 mm long; pollen-presenter not rimmed; leaf mucro short and blunt .... **G. acerata**

The key to the *Buxifolia* Group *sensu* Makinson (Makinson 2000: 328) may be altered by insertion of an additional couplet in the following way.

9. Leaf upper surface smooth .... **G. umbellulata**

9: Leaf upper surface granular-scabrid

9a. Flowers adaxially oriented .... **G. hislopii**

9a: Flowers abaxially oriented .... **G. occidentalis**

2. Grevillea althoferorum P.M.Olde & N.R.Marriott, in *Nuytsia* 9(2): 295–297 (1993b), as 'althoferi'.

Type: near Eneabba, Western Australia [precise localities withheld for conservation reasons] 15 September 1991, *P.M. Olde* 91/102 (*holo*: NSW; *iso*: PERTH 02690780, PERTH 04700120).

A full description is included in Olde & Marriott (1993b: 295–297).

Affinities. *Grevillea althoferorum* is a member of Group 41 *sensu* Olde and Marriott (1994c: 221) which is equivalent to the *Rudis* Group *sensu* Makinson (2000). This distinctive group comprises five species; *G. althoferorum*, *G. pulchella* (R.Br.) Meisn., *G. rudis* Meisn., *G. stenostachya* C.A.Gardner and *G. tenuiflora* (Lindl.) Meisn. All species in this group have actinomorphic perianths, the outer perianth surface with glandular hairs (except *G. stenostachya*), hairy ovary with some or all hairs glandular, style with a sigmoid fold around halfway, distal half of style below the pollen-presenter gradually dilated and either granulose, tuberculose or papillose and fruits with glandular hairs. The style characters are unique within *Grevillea* and comprise a synapomorphy for the group.

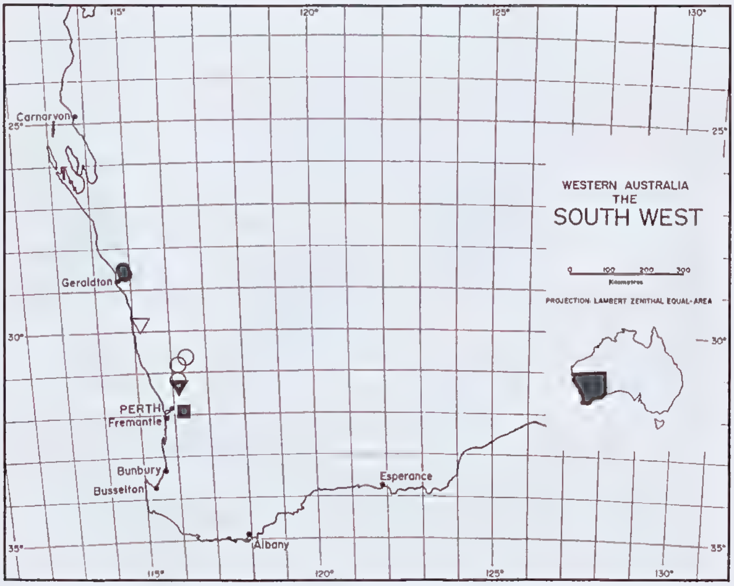

Figure 2. Distribution of *Grevillea hislopii* (■), *G. althoferorum* subsp. *althoferorum* (▽), *G. althoferorum* subsp. *fragilis* (▼), *G. bracteosa* subsp. *bracteosa* (○), *G. bracteosa* subsp. *howatharra* (●) in south-west Western Australia.

In at least two species (*G. rudis* and *G. stenostachya*), flowering continues over more than a single season with flowers and fruits frequently present on the same rachis, a character-state unique in *Grevillea*. This character-state may also be present in *G. althoferorum* which has an extended flowering season, but fruit-set is very low (fruits and seeds not yet seen). McGillivray and Makinson (1993: 395) have also observed of *G. stenostachya* that 'the inflorescence is sometimes interrupted by a leaf', an unusual character observed in one other unrelated species (e.g. *G. alpina* Lindl.). The group appears to have no close relatives. There is remote affinity with our Group 1 (*Triloba* Group *sensu* Makinson 2000) through the small, white to creamy, actinomorphic perianths, and the presence of stylar dilation (albeit quite different in character), and our Group 7 (*Petrophiloides* Group *sensu* Makinson) through the actinomorphic perianth and glandular fruits. Floral abnormalities have been observed in *G. pulchella* by McGillivray and Makinson who reported flowers with five tepals and some with three (McGillivray & Makinson 1993: 394).

There are two ecogeographically and morphologically distinct populations of *G. althoferorum*, the most southerly being recognised and described here as subsp. *fragilis* P.M.Olde & N.R.Marriott.

Note. Primary leaf lobes have been measured at the subapical sinus, just below the point where the lobes divide.

Key to subspecies

1. Leaf lobes 1–3 cm wide; longest terminal spines 2.5–3.5 mm long, rigid, pungent; perianth limb 1.5–2 mm wide with creamy hairs; pollen-presenter *c.* 0.8 mm long .... subsp. **althoferorum**

1: Leaf lobes 0.25–0.35(–0.5) cm wide; longest terminal spines 0.5–1.5 mm long, brittle, scarcely pungent; perianth limb 1–1.25 mm wide with white hairs; pollen-presenter 0.8–1.5 mm long .... subsp. **fragilis**

Grevillea althoferorum subsp. althoferorum

Primary leaf lobes (see *Note* above) 0.5–1.3 cm wide; longest spines of leaves and leaf lobes 2.5–3.5 mm long, rigid, pungent; perianth 5–6 mm long, 1.5–1.8 mm wide, densely glandular-villous abaxially with cream to brownish-cream hairs; perianth limb 1.5–2 mm long, 1.5–2 mm wide; stylar dilation *c.* 0.4 mm wide at its widest point; pollen-presenter distinctly rimmed at base, *c.* 0.8 mm long, 0.6–0.7 mm wide.

Specimens examined. See Olde and Marriott (1993b: 296).

Distribution. Known from a solitary small population south-west of Eneabba (Figure 2).

Habitat and ecology. Grows in grey sand over laterite in open kwongan dominated by *Grevillea biformis* subsp. *cymbiformis*, *Grevillea shuttleworthiana* subsp. *canarina* and *Eucalyptus* sp. aff. *tetragona*.

Conservation status. Listed as Declared Rare Flora under the Western Australian *Wildlife Conservation Act 1950* with a ranking of Threatened (Atkins 2008) at the species level.

Grevillea althoferorum subsp. **fragilis** P.M.Olde & N.R.Marriott, *subsp. nov.*

Ab subspecie typica foliorum lobis minoribus spinis brevioribus fragilibus, perianthii limbo minore, trichomis albis, pollinis praebitore longiore differt.

Typus: Bullsbrook, Western Australia [precise locality withheld for conservation reasons], 6 September 2002, *P.M. Olde* 02/84 & *N.R. Marriott* (*holo*: PERTH 07692439; *iso*: CANB, K, MEL, NSW 535800, NY, PERTH 07692420).

Primary leaf lobes (see *Note* above) 0.25–0.35(–0.5) cm wide; longest spines of leaves and leaf lobes 0.5–1.5 mm long, brittle, scarcely pungent; perianth 6–7 mm long, 1 mm wide, densely glandular-villous abaxially with white hairs; perianth limb 1.5 mm long, 1–1.25 mm wide; stylar dilation *c.* 0.25 mm wide at its widest point; pollen-presenter distinctly rimmed at base, 0.8–1.5 mm long, 0.35-0.6 mm wide. (Figure 3)

Distribution. Known only from a small population at Bullsbrook.

Habitat and ecology. Grows in deep yellow sand in *Banksia–Corymbia* woodland with *Corymbia calophylla, Banksia menziesii, B. attenuata, B. grandis, Adenanthos cygnorum, Hibbertia* sp., *Ptilotus manglesii, Xanthorrhoea* sp., *Mesomelaena tetragona, Stirlingia latifolia, Lobelia* sp., *Isopogon* spp. and *Petrophile* spp.

Flower colour. Perianth yellow with reddish to reddish-brown buds.

Flowering period. Spring

Fruiting period. Unknown (no fruits have been seen).

Conservation status. Listed as Declared Rare Flora under the Western Australian *Wildlife Conservation Act 1950* with a ranking of Threatened (Atkins 2008) at the species level. Subsp. *fragilis* is known only from the population at the type location where there are approximately 50 plants.

Etymology. Taken from the Latin *fragilis* – brittle, a reference to the brittle spines terminating the leaf lobes.

3. Grevillea bracteosa Meisn. in J.G.C.Lehmann, *Plantae Preissianae* 2: 254 (1848).

Type: Western Australia: Swan River *Drummond* coll. 3 no. 269 (*holo*: NY (photo seen); *iso* [*fide* Makinson 2000: 187 which differs substantially from McGillivray and Makinson 1993: 409] BM *n.v.*, K *n.v.*, LE (*n.v.*), MEL 47006, NY (photo seen), P *n.v.*, PERTH 02648709).

Description. McGillivray and Makinson (1993: 375) and Olde and Marriott (1995a: 69–70) provide a comprehensive broad description of the species.

Affinities. Grevillea bracteosa has an uncertain relationship with *G. scapigera* A.S.George with which it shares some floral features. In our scheme (Olde & Marriott 1994c:189–221) we kept these two taxa in separate single-species groups of uncertain affinity (Groups 36 & 37). Subject to DNA analysis it is

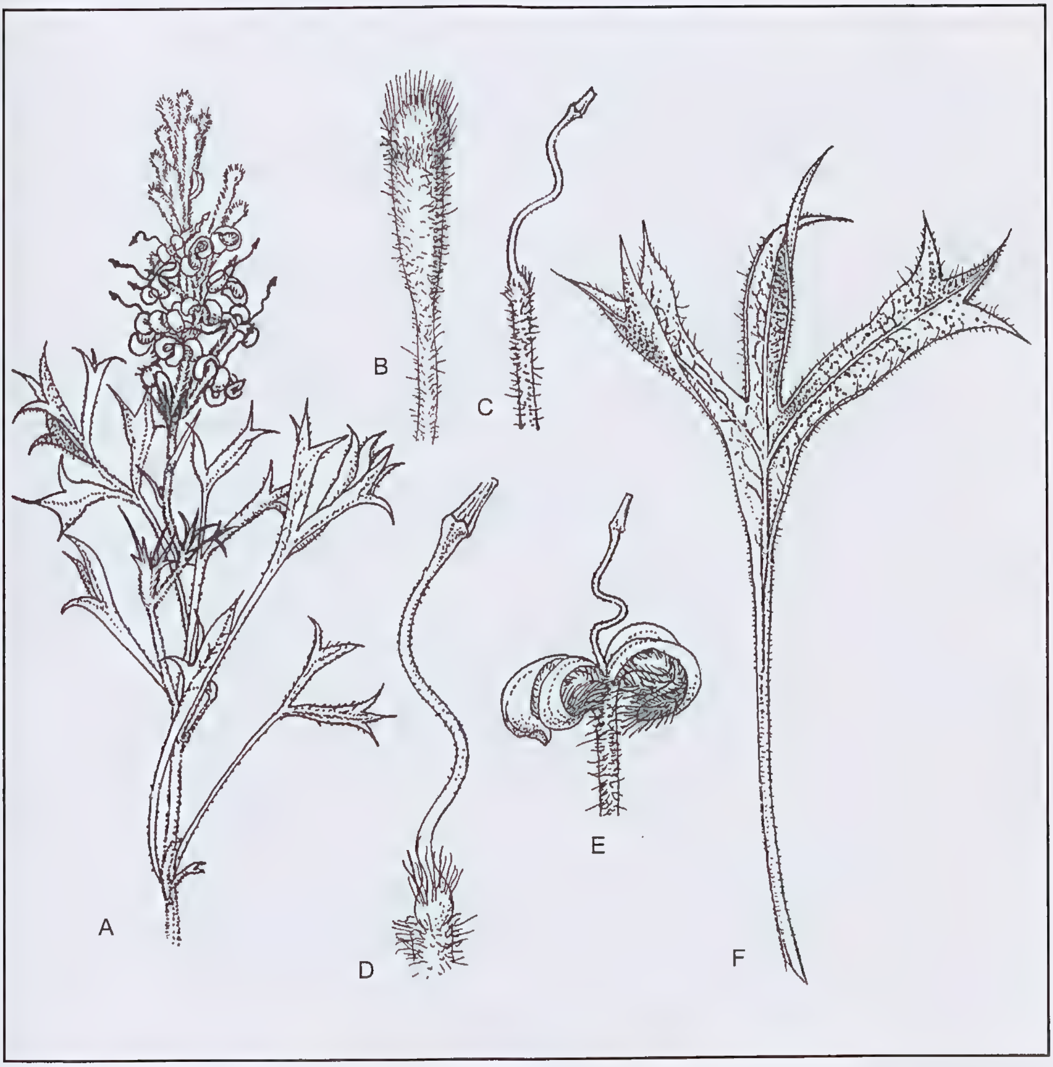

Figure 3. *Grevillea althoferorum* subsp. *fragilis*. A – habit of plant (×1); B – perianth prior to anthesis (×4); C – pistil (× 4), D – pistil showing nectary at base (× 8); E – perianth after anthesis in relation to the pistil (× 4); F – leaf (×2).

possible that these two groups will be combined. More recently Makinson (2000) has included both species in his *Hakeoides* Group which superficially to us appears to render that group polyphyletic.

Discussion. McGillivray and Makinson (1993: 375) noted that the ‘flowers are smaller in collections from the southern parts of the species’ range’. Plants from this part of the range were recognised as the ‘small-conflorescence form’ by Olde and Marriott (1995a: 70). It was later realised that this form was entirely consistent with the type specimen and it is therefore included here in subsp. *bracteosa*. Our studies have shown that morphological differences in relation to conflorescence size correlate with geographic and ecological differences. Two subspecies are accordingly recognised.

Key to subspecies

1. Floral rachis 3–5 mm long; pedicels 0.18–2.5 mm long; swollen portion of style-end 0.75 mm thick .... subsp. **bracteosa**

1: Floral rachis 8–12 mm long; pedicels (3.25–)4–5.75 mm long; swollen portion of style-end 1–1.75 mm thick .... subsp. **howatharra**

Grevillea bracteosa subsp. bracteosa

The 'small-conflorescence' form *sensu* Olde and Marriott (1995a: 70).

Unit conflorescence 1.3–1.5 cm wide, dense; floral bracts 4–7.5 mm long, 5–7 mm wide; floral rachis 3–5 mm long; pedicels 0.18–2.5 mm long; pistil 15.5 mm long; ovarian stipe 5 mm long; swollen portion of style-end 2.25–2.5 mm long, 0.75 mm thick.

Selected specimens (30 examined). WESTERN AUSTRALIA: [localities withheld for conservation reasons] 15 Sep. 1999, *J.W. Horn* 2477 (PERTH 05643201); 12 Oct. 2005, *F. Hort* 2637 (NSW, PERTH); 9 Nov. 2005, *F. Hort* 2688 (NSW, PERTH); 21 Jan. 2006, *F. Hort & J. Hort* 2771 (NSW, PERTH); 3 Oct. 1996, *F. Mansfield* 1 (PERTH 04662822), 10 Sep. 1986, *P.M. Olde* 86/343 (NSW 534828); 10 Sep. 1986, *P.M. Olde* 86/882 (NSW 534830); 10 Sep. 1986, *P.M. Olde* 86/883 (NSW 534829); 21 June 2006, *P.M. Olde* 06/02 *& F. Hort* (NSW); 12 Sep. 2004, *P.M. Olde* 04/65 *& D. Shiells* (NSW, PERTH); 19 Oct. 1999, *L. Polomka & S. Patrick* SP 3289 (PERTH 05541018); 30 Nov. 1990, *B.H. Smith s.n.* (CANB, HO, MEL 2015483, S); Oct. 1934, *H. Steedman s.n.* (PERTH 02357674).

Distribution. Western Australia, between southern side of Bindoon Training Area, Toodyay, to the Babilion Range and Mogumber in the west, from east of Miling to Dalwallinu in the north and north-east, from Gabalong to Bindi Bindi in the east (Figure 2).

Habitat and ecology. Grows in open heath in yellow granite-derived sandy clay-loam with laterite.

Flowering period. Spring.

Fruiting period. Late spring.

Conservation status. Listed as Declared Rare Flora under the Western Australian *Wildlife Conservation Act 1950* with a ranking of Threatened (Atkins 2008) at the species level. Recent discovery of at least five populations, one with almost 2000 individual plants, in the Bindoon Army Training Area and adjacent areas of the proposed Julimar Conservation Park by Mr Fred Hort, now suggests that this subspecies has a lower conservation priority and its current status may warrant review.

Notes. White-flowered and deep pink to mauve-pink flowered plants have been recorded from the population on private property east of Miling. These plants have great horticultural potential.

Grevillea bracteosa subsp. howatharra P.M.Olde & N.R.Marriott, *subsp. nov.*

Ab subspecie *bracteosa*, conflorescentiis latioribus, rachididibus, bracteis florum, et pedicellis longioribus, apice styli crassiore differt.

Typus: Moresby Range, Western Australia [precise locality withheld for conservation reasons] *s. dat.*, *D. & N. McFarland* 1131 (*holo*: NSW 620583; *iso*: PERTH 01645994).

Unit conflorescence 2 cm wide, moderately dense to open; floral bracts 8.5–10 mm long, 4.5– 5 mm wide; floral rachis 8–12 mm long; pedicels (3.25–)4–5.75 mm long; pistil 16.2–21 mm long; ovarian stipe 5–6.5 mm long; swollen portion of style-end 2.5–3.25 mm long, 1–1.75 mm thick.

Selected specimens (27 examined). WESTERN AUSTRALIA: [localities withheld for conservation reasons] 3 Dec .1961, *Beard & Lullfitz* L25 (NSW 82905); 17 Sep. 1971, *A.C. Burns* 94 (PERTH 02357720); Sep. 1963, *E. Duffield s.n.* (PERTH 02357739); 13 Sep. 1977, *A.S. George* 14867 (NSW 620584, PERTH 1646028); 9 Sep. 2002, *P.M. Olde* 02/118 *& N.R. Marriott* (NSW 535348); 30 Sep. 1962, *M.E. Phillips* (CANB, NSW 118476).

Distribution. Western Australia, in three small areas north, east and north-east of Geraldton.

Habitat and ecology. Grows in heavy soils in open sunny positions. Soils are clay loam with laterite. Associated species include *Grevillea pinaster* Meisn.

Flowering period. Spring.

Fruiting period. Late spring.

Conservation status. Listed as Declared Rare Flora under the Western Australian *Wildlife Conservation Act 1950* with a ranking of Threatened (Atkins 2008) at the species level. Subsp. *howatharra* is known from few localities, at none of which it is abundant, and its conservation status should remain unchanged.

Etymology. Named for Howatharra Reserve wherein grows this subspecies at its most northerly distribution. The epithet is used as a noun in apposition and is not declinable.

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Seorsus a new Gondwanan genus of Myrtaceae with a disjunct distribution in Borneo and Australia

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Abstract

Rye, B.L. & Trudgen, M.E. *Seorsus*, a new Gondwanan genus of Myrtaceae with a disjunct distribution in Borneo and Australia. *Nuytsia* 18: 235–257 (2008). The new genus *Seorsus* Rye & Trudgen (Myrtaceae tribe Chamelaucieae) has four species, two in Borneo and one each in the north of the Northern Territory and the south-west of Western Australia. *Seorsus* is distinguished from related genera by the shape of its anther connective, the orientation of its anther loculi and its distinctly facetted seeds. Two of its four species were previously placed in *Astartea* DC., a third in *Baeckea* L. and the fourth is the new species *Seorsus aequatorius* Rye & Trudgen. Three new combinations, *S. clavifolius* (C.A.Gardner) Rye & Trudgen, *S. intratropicus* (F.Muell.) Rye & Trudgen and *S. taxifolius* (Merr.) Rye & Trudgen, are made. The morphological characteristics, Gondwanan distribution and relationships of the new genus are discussed. Descriptions, keys, illustrations and distribution maps are provided.

Introduction

This paper describes *Seorsus*, a new genus of Myrtaceae tribe Chamelaucieae (*sensu* Wilson *et al.* 2005) with four species, two in Australia and two in Borneo. While *Seorsus* is distinguished primarily by its anther morphology, a more obvious characteristic of the new genus is its stamen arrangement, with the filaments united into fascicles opposite the sepals. This arrangement is common in the related genus *Astartea* DC., but is very rare elsewhere in the Myrtaceae.

It was the presence of antisepalous fascicles that resulted in the two Australian species of *Seorsus* originally being included in *Astartea*. Mueller (1859) described *A. intratropica* from material he had collected in the Roper River area of the Northern Territory, giving an accurate description of its unusual anthers, which have the connective dilated at the base, the loculi facing sideways and a ventral gland. Bentham (1867: 89) was also aware that the anther type of *A. intratropica* was distinctive, separating this species in his *Astartea* key on the basis that it had transverse rather than longitudinal dehiscence (although this is not an entirely correct interpretation of the anther morphology of this species, as discussed in the morphology section below). Later, when Gardner (1942) described the south-western Australian species *A. clavifolia*, he apparently mistook its separated anther loculi for individual anthers, as he recorded twice as many stamens as were actually present.

The existence of a third species of *Seorsus* from the Malaysian part of Borneo was brought to our attention by Peter Wilson in 2006. Despite having its stamens in antisepalous fascicles, this species was originally described as *Baeckea taxifolia* Merr. (Merrill 1928) and later transferred to the genus *Babingtonia* Lindl. by Bean (1997). A new species of *Seorsus*, occurring in the Indonesian region of Kalimantan, was discovered when herbarium material from Borneo was examined in the current study.

Molecular studies (Lam *et al.* 2002, Wilson *et al.* 2004 and unpublished data), which are discussed in more detail below, have provided evidence that the two Australian species are related to one another, but should not be included in the genus *Astartea*. Our morphological evidence indicates that *Seorsus* is not the only group needing to be separated from *Astartea s. lat.* Like *Seorsus*, the genus *Cyathostemon* Turcz. has long been included partly in *Astartea s. lat.* and partly in *Baeckea* L. *s. lat.* A future paper (Trudgen & Rye in prep.) will reinstate *Cyathostemon*. For convenience, all further references to *Astartea* in this paper will mean *Astartea* in the strict sense, excluding both *Seorsus* and *Cyathostemon*.

The taxonomic significance of the distinctive anthers found in *Seorsus*, and other characters that are of value in either distinguishing the new genus or clarifying its affinities to other genera, are discussed below.

Methods

All measurements were made from dry pressed material. Multiple images of young stems and seeds were taken with a Nikon Digital Camera Head (DS-5M) controlled by a DS Camera Control Unit (DS-L1) and a montage of the images was collated using Synoptics Auto-Montage Pro Version 5.03.0061 software.

Molecular evidence

Recent molecular studies of chloroplast DNA for the tribe Chamelaucieae (Lam *et al.* 2002, Wilson *et al.* 2004), have used the following three regions: the *mat*K gene and the adjacent 5' *trn*K intron, part of the *ndh*F gene and the *atp*B-*rbc*L intergenic spacer. In each of the cladograms presented, a strongly supported clade was obtained comprising all of the species sampled for *Astartea*, *Cyathostemon* and *Hypocalymma* (Endl.) Endl., but excluding the *Seorsus* species.

The phylogenetic tree presented by Wilson *et al.* (2004) included both of the Australian species of *Seorsus*, which formed a clade with moderately high support. This clade was sister, but with weak support, to a clade comprising species of *Aluta* Rye & Trudgen and *Thryptomene* Endl. In a previous analysis (Lam *et al.* 2002), when only *Seorsus intratropicus* was sampled, that species was sister, again with minimal support, to a clade formed by members of *Baeckea* subgenus *Hysterobaeckea* Nied. In both of these studies, *Seorsus* species showed no evidence of any close relationship with the three species sampled of *Astartea*, which were *A. aspera* Schauer, *A. astarteoides* (Benth.) Rye [both included as *A. fascicularis* (Labill.) DC.] and *A. arbuscula* (Benth.) Rye [as *Baeckea arbuscula* Benth.].

Unpublished analyses based on the nuclear ETS region have placed *Seorsus intratropicus* in a weakly supported sister position to the strongly supported *Astartea-Cyathostemon-Hypocalymma* clade (Peter Wilson, pers. comm. 2008). Separation of the latter three genera was also achieved, with

Astartea in a weak sister position to *Cyathostemon* and *Hypocalymma*, which were weakly separated from one another.

It is concluded on the basis of all the available molecular evidence that *Seorsus* is probably more closely related to *Astartea*, *Cyathostemon* and *Hypocalymma* than to any other genera in the tribe Chamelaucieae. However, as *Seorsus* is not found within the strongly supported *Astartea-Cyathostemon-Hypocalymma* clade in any of the chloroplast and nuclear DNA analyses, the molecular evidence supports recognition of this new genus.

Morphology

The main characters that need to be understood in determining the affinities and distinctiveness of *Seorsus* are discussed. As *Astartea, Cyathostemon* and *Hypocalymma* appear to be the closest relatives of *Seorsus* from both morphological and molecular evidence, the similarities to and differences from these three genera are outlined below. The four genera are also compared in Table 1.

Vegetative characters

Habit. Seorsus clavifolius is a medium-sized, erect shrub reaching 1.4 metres tall and *S. taxifolius* has similar stature, reaching 1.3 m tall, but is sometimes described as prostrate on herbarium labels – presumably when it has been collected from exposed situations. A somewhat greater maximum height of 1.7 metres is recorded for *S. intratropicus*. No habit information is available for *S. aequatorius*, but the largest branch on the holotype is over 0.3 m long and its stem diameter suggests a height of over a metre for the plant.

Like many species of *Astartea*, and some species of *Cyathostemon* and *Hypocalymma*, *Seorsus clavifolius* has a marked lignotuberous habit with numerous stems, often 20–40, emerging at ground level. This type of habit is rare among the Chamelaucieae and appears from our field observations to be absent in almost all of the other capsular Western Australian members of the tribe. However, some members of the eastern Australian and South East Asian genus *Baeckea s. str.* are also lignotuberous.

Seorsus intratropicus is probably not lignotuberous (Andrew Mitchell pers. comm.) and there is no information available on this character for the two species from Borneo. Non-lignotuberous species also occur in *Astartea*, *Cyathostemon* and *Hypocalymma*, so there is nothing unusual in having both kinds of habit within a genus. What is unusual is that each of these genera does contain some species with a pronounced lignotuberous habit.

Stems. The four species of *Seorsus* have sub-terete young stems, but with swellings formed by a thick sub-epidermal layer covered by a pale grey epidermis. The arrangement of these swellings, which extend two nodes below the base of each petiole – down to the top of the next petiole of the same orientation – may make the stems somewhat quadrangular. Each patch of pale grey epidermis may be noticeably expanded laterally beyond the margins of the petiole as in *S. taxifolius* (Figure 1C) or more closely lined up with the margins of the petiole as in *S. aequatorius* (Figure 1B). As the young shoots age, the thick sub-epidermal layer dies and becomes transversely fissured, giving the older part of the shoots a distinctive appearance, before it is shed. The fissuring of the stem tissue is particularly broad and deep in *S. taxifolius* (Figure 1C) and is least developed in *S. clavifolius*.

Table 1. Comparison of *Astartea*, *Cyathostemon*, *Hypocalymma* and *Seorsus*.

Genus	***Astartea***	***Cyathostemon***	***Hypocalymma***	***Seorsus***
Distribution	south-west WA, concentrated in extreme south-west	south-west WA, concentrated in the south and extending into interzone	south-west WA, concentrated in northern sandplains	south-west and northern Australia, and high altitudes in Borneo
Flowering branches				
Transversely-fissured stem tissue	absent	absent or rare	absent or rare	present
Leaf fascicles	usually present	absent or slightly developed	absent	absent
Flowers per peduncle	usually 1	1	2–4 in most species	1
Androecium				
No. of whorls	1 or 2	1 or partially 2	2 or 3, rarely almost 1	1 or 2
Stamen number	3–60	8–30	10–120 or more	15–30, 57–78
Stamen fusion	in fascicles or free	in a uniform or partly divided long ring	usually in a uniform short ring	in fascicles
Stamen placement	all or mostly opposite the sepals	continuous or grouped opposite sepals	continuous or rarely opposite sepals	all opposite the sepals
Anther cells	± parallel	± parallel	± parallel or curved	very divergent at base
Connective gland	terminal	terminal	terminal or ventral	ventral
Processes	present	absent	absent	absent
Gynoecium				
Ovules per loculus	1–23	1–9	1–12	6–16
Ovule colouring	usually ± uniform	distinctly two-toned	usually ± uniform	uniform
Style base	close to placentas	close to placentas	close or distant	distant from placentas
Stigma	peltate	usually capitate	usually capitate	peltate
Fruit				
Position	± half-inferior	usually largely superior	± half-inferior to superior	largely inferior
Wall and valves	usually thin	thick	thick	thin
Functional loculi	1–3	2 or 3	1–4	2 or 3
Seeds				
Seed facets	absent or poorly developed	absent or very poorly developed	absent or very poorly developed	pronounced
Length	0.5–1.3 mm	1.3–2 mm	0.8–2.3 mm	0.6–1.4 mm
Embryo	broadest near base	broadest near apex	broadest near base	broadest near base
Testa thickness	usually rather thin	thick	thick	thick
Inner proliferation	curved	curved	curved	angular or absent

Astartea, *Hypocalymma* and *Cyathostemon* show great variety in their stem morphology; for example their young shoots can be prominently winged, or have a variety of types of tubercles (Figure 1A) or hairs. The epidermis and underlying tissue are usually shed in longitudinal strips (Figure 1A) or may be somewhat more fibrous or shed in patches. Transverse fissures similar to those found in *Seorsus* have been observed in a few species of *Cyathostemon* and *Hypocalymma* but not in *Astartea*.

Leaves. In *Astartea* many species have most of their leaves crowded on short shoots into leafy fascicles, although widely spaced pairs of leaves are also quite common on rapidly growing stems. *Cyathostemon* has some species with the leaves crowded onto short shoots, but less obviously than in *Astartea*, while *Hypocalymma* shows no tendency for the leaves to be in fascicles. The fasciculate leaf arrangement is also completely absent in *Seorsus*, which has leaves in pairs fairly uniformly distributed along the branchlets.

The leaves in *Astartea* are consistently thick and narrow, with a poorly defined petiole but usually with sharply defined margins. The species of *Seorsus* from Borneo and northern Australia also have thick narrow leaves with a poorly defined petiole (Figure 1B & C). However, the south-western Australian species, *S. clavifolius*, differs in having a well-defined petiole and a shorter blade with a slightly to distinctly broader shape. In both *Cyathostemon* and *Hypocalymma* the leaves are more varied, ranging from broad and flat to thick and narrow.

Inflorescence

All *Seorsus* species have solitary, pedunculate, axillary flowers. The number of flowers on a branchlet varies from two (rarely only one developing) to about 16. The flowers can be in the upper leaves of a branchlet (sometimes appearing to be terminal, but with the stem bud present and probably dormant), or well away from the growing tip. Each peduncle is terminated by a pair of opposite bracteoles, above which the pedicel is about as long as the peduncle in *S. clavifolius*, but shorter than the peduncle in *S. intratropicus* and absent in the two species from Borneo.

Cyathostemon is similar to *Seorsus* in having solitary axillary flowers, but differs in its better-developed pedicels, which are usually much longer than the peduncles. *Astartea* is similar to *Seorsus* in having its peduncles well developed and its pedicels varying from well developed to more or less

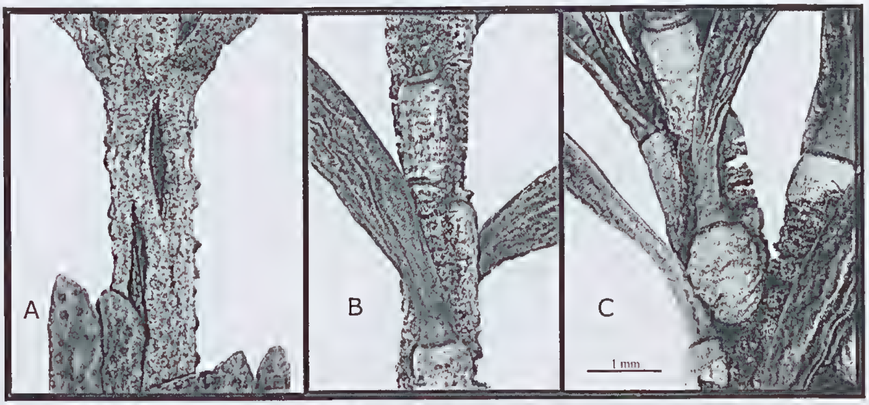

Figure 1. Epidermis appearance and dehiscence patterns on young leafy stems. A – *Astartea aspera* Schauer; B – *Seorsus aequatorius*; C – *Seorsus taxifolius*. Digital images prepared by Alex Williams from *B.E. Hall* 30a (A), *H. Hallier* 2308 (B) and *I. Paie* S.26456 (C).

absent. *Hypocalymma* can usually be readily distinguished from the other genera by its inflorescence, as most species have pairs of more or less sessile flowers in a leaf axil. However a few species of *Hypocalymma* have long peduncles and/or pedicels, and some regularly produce solitary flowers, although there can be up to four flowers per axil.

Among the *Seorsus* species, the bracteoles vary from leaf-like to partially scarious. The largest, most persistent, bracteoles are those of *S. taxifolius*, these being leaf-like and about 3 mm long. There is also considerable variation in bracteole morphology among the other three genera.

Androecium

Stamen number. In the two Australian species of *Seorsus*, the number of stamens varies not only between flowers on the same plant but also between fascicles in the same flower. *Seorsus clavifolius* has moderately numerous stamens (17–23) and *S. intratropicus* has very numerous stamens (57–78). However, the two species from Borneo seem to have relatively constant numbers of stamens per fascicle and per flower. In *S. aequatorius* there are usually six stamens per bundle and 30 stamens per flower, while *S. taxifolius* usually has three stamens per bundle and 15 stamens per flower. Each of these four species can therefore be distinguished from the others by its stamen number.

The other three genera have a continuous range of stamen numbers, from 3 to 60 in *Astartea*, from 8 to 30 in *Cyathostemon*, and from 10 to over 120 in *Hypocalymma*.

Stamen arrangement. In *Seorsus*, all of the stamens are in well-defined antisepalous fascicles, with two to 18 stamens per fascicle. Antisepalous fascicles are also common in *Astartea*, with up to 13 stamens each, but fascicles are sometimes poorly defined and are not always present. Those species of *Astartea* with a much reduced number of stamens have only free stamens, whereas those species with high numbers of stamens sometimes have a mixture of antisepalous fascicles and solitary antipetalous stamens or staminodes; or if they only have fascicles the long marginal filaments may loose the anther to form staminodes.

In *Hypocalymma*, which often has very numerous stamens united at the base into a continuous ring of uniform height, there are usually two or three adjacent whorls of stamens, with stamens of the innermost whorl shortest. *Cyathostemon* species have a single whorl of stamens when there are few of them but sometimes have a partial shorter second whorl when stamens numbers are higher. The filaments are flattened in *Cyathostemon* and are all united at the base into a tube but the individual stamens vary in length and are fused for varying lengths, sometimes superficially giving the impression of fascicles. Often there are alternating long and short stamens around the ring.

Seorsus intratropicus has its numerous stamens densely clustered into the fascicles (Figure 2H), which spread out at the base so that their margins extend towards the adjacent fascicles but do not join them. The stamens are in two whorls, the outer whorl longer than the inner one but with both whorls having a general progression from the longest filaments on the margins of each fascicle to the shortest in the centre. The two whorls are fused for much of the length of the filaments, with the filaments located on the margins of the fascicle fused for a shorter length than the next pair in. As a result of both their greater overall length and shorter length of fusion, the free part of the marginal stamens tends to be much longer that that of the other filaments. Exactly the same arrangement of the stamens of each fascicle can be seen in *Astartea* species that have large numbers of stamens per flower.

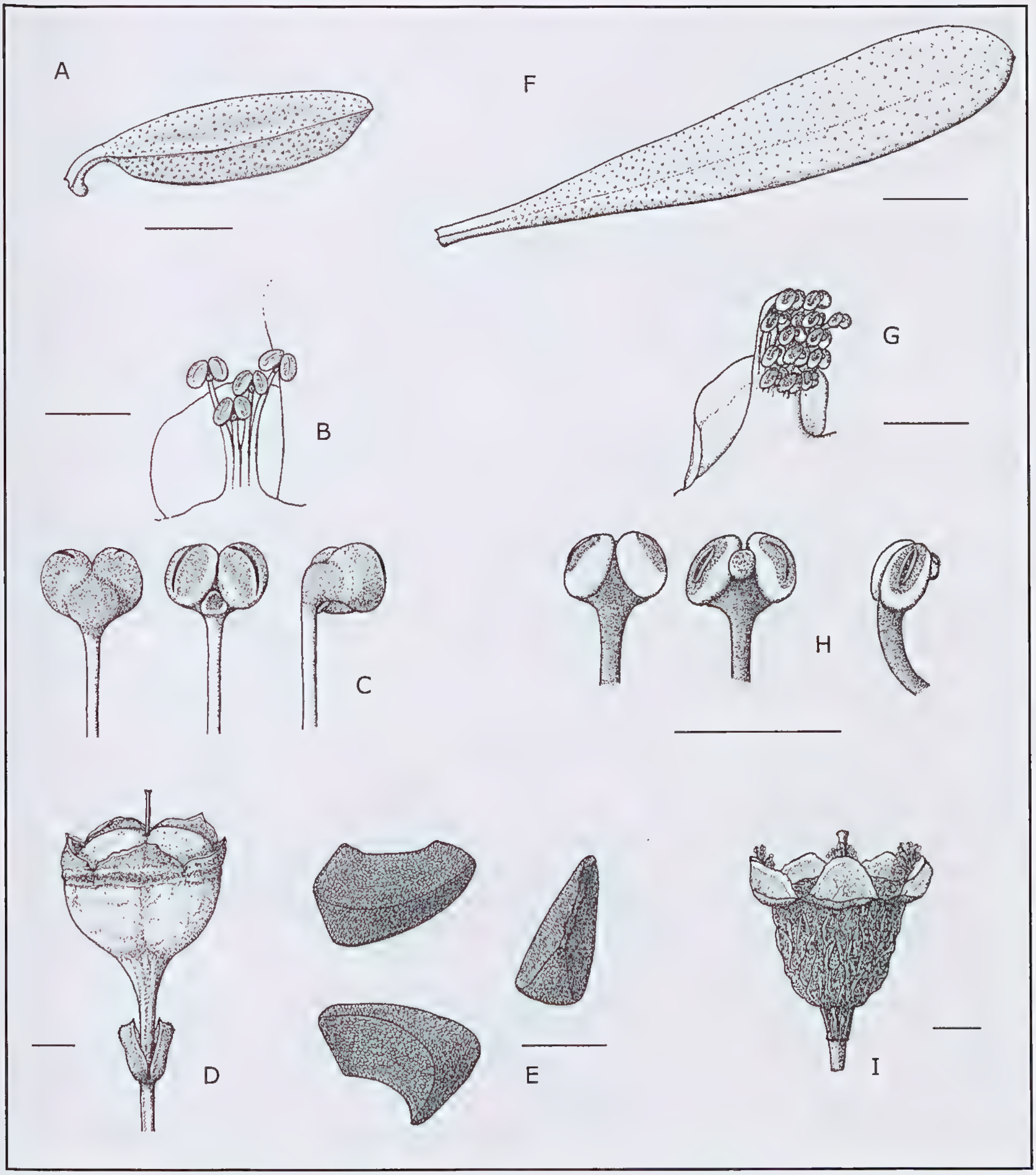

Figure 2. A–E. *Seorsus clavifolius*. A – leaf; B – stamen fascicle; C – three views of anther; D – bracteoles and fruit prior to dehiscence; E – three views of seed; F–I. *Seorsus intratropicus*. F – leaf; G – stamen fascicle; H – three views of anther; I – young fruit with three of the five stamen fascicles still attached. Scale bars all 1 mm. Drawn by Lorraine Cobb from *D. Papenfus* 721 & *K. Macey* (A–E) and *P.K. Latz* 10117 (F–I).

With only 2–6 stamens in each fascicle, the arrangement of the stamens in *Seorsus clavifolius* is simpler and more obvious. The fascicles arise more abruptly at the base so that their margins are more or less parallel, with the stamens arranged in a single whorl and the filaments becoming progressively shorter from the margins to the centre (Figure 2C). The two *Seorsus* species from Borneo, and also those *Astartea* species that have similar stamen numbers, match *S. clavifolius* in the arrangement of stamens in their fascicles. A similar arrangement of short and long stamens occurs in at least one species of *Cyathostemon* and in *Hypocalymma cordifolium* subsp. *minus* Keighery & Strid, although in the former the stamen groups are united also to one another to form a complete ring and in the latter the filaments are separated at the base rather than being united. Of all the species in the latter two genera, *Hypocalymma scariosum* Schauer is the only one that sometimes has true antisepalous fascicles. When stamen numbers are reduced in that species to 12–15 per flower, there are gaps opposite the petals and the contiguous filaments are very shortly united at the base into slight fascicles with the outermost stamens longest.

While the consistent arrangement of the longest stamens outermost in antisepalous fascicles may seem peculiar, it reflects the general tendency among the Myrtaceae for the longest stamens to be opposite or closest to the centre of each petal and the shortest stamens to be opposite or closest to each sepal. This means that when stamen fascicles are produced opposite the petals, as in genera such as *Melaleuca* L., the longest stamens are located at the centre of the fascicle.

Stamen type. The stamens of *Seorsus*, *Astartea*, *Cyathostemon* and *Hypocalymma* all have non-versatile anthers with the filament flattened at the base where it joins the staminophore.

The attachment of the filaments to the connective is more variable, ranging from truly basifixed, through attached very close to the base of the connective, to attached to the lower part of the back of the connective. In *Seorsus*, the top of the filament broadens where it joins the connective, which is noticeably broader at the base than in the upper part. Below this broad connection, the free part of the filament is narrow. In the other three genera, the connective usually remains the same width from top to bottom and certainly never broadens markedly at the base as in *Seorsus*.

Anther loculi. In all species of *Seorsus*, *Astartea*, *Cyathostemon* and *Hypocalymma*, the anther loculi are longer than wide and open by longitudinal slits. However, the orientation of the loculi varies in two ways. Firstly, the loculi can vary from being side by side and facing inwards (introrse) through to being back to back (fully latrorse), but with their long axes still remaining parallel to each other and to the long axis of the connective. Secondly, they can diverge either at the base or at the top so that they are no longer parallel to the connective or to each other. The latter morphology only occurs in species where the loculi are partially to fully latrorse.

In *Seorsus*, the anther loculi are always latrorse and also well separated at the base so that they are very distinctly inclined towards one another at the top (Figure 2C & H). While there is much variation in *Astartea*, both between and within species, the most common situation is for the loculi to be both introrse and parallel. However, if the loculi are more latrorse, they may rarely be somewhat inclined away from one another at the base, but never approaching the degree of inclination found in *Seorsus*.

The large degree of inclination (*c.* 45 degrees from each axis of the connective) of the loculi in *Seorsus* is sufficient to give a very different appearance to the anthers compared to those of *Astartea*, *Cyathostemon* and *Hypocalymma*. Bentham (1867) described *Astartea fascicularis* and *Cyathostemon* [as *Astartea ambigua*] as having anthers with longitudinal dehiscence and those of *Seorsus intratropicus* [as *Astartea intratropica*] as having transverse dehiscence. In fact the dehiscence is still along the length of the loculi, not across them; what has changed is the orientation of the loculi, not the direction of dehiscence.

Connective gland. In most genera of the Myrtaceae, including *Astartea* and *Cyathostemon*, the connective gland is located on the outer, i.e. dorsal, surface of the anther at the distal end of the connective. However, in *Seorsus* the connective gland is visible on the inner, i.e. ventral, surface of the anther. The position of the gland varies from being terminal on the ventral surface of the connective as illustrated for *S. intratropicus* (Figure 2H) to being close to the base of this surface as illustrated for *S. clavifolius* (Figure 2C), although the position often varies between these extremes even between stamens of the same fascicle. The two species from Borneo have very similar anther morphology to the two Australian species.

This apparent change in the position of the connective gland in relation to the loculi is an unusual phenomenon in the tribe Chamelaucieae. However, a somewhat similar development is found in a number of *Hypocalymma* species. In these species the anther loculi are often markedly curved, separating from one another at the middle around an apparently ventral connective gland but converging with one another at the top and base of the anther, as illustrated in Rye (1987: fig. 155D).

Processes. Small hair-like structures that are inserted between the petals and stamens are common in some genera of the Chamelaucieae and are referred to as processes. They are often present in *Astartea*, but have not been found in *Seorsus*, *Cyathostemon* and *Hypocalymma*.

Gynoecium and fruit

Depth of insertion of style base. Each of the *Seorsus* species has an inferior ovary that is fused to most of the length of the hypanthium and has a broad disc across its summit. At the centre of the disc there is a depression where the terete base of the style is inserted between the two, or more commonly three, loculi. In *Astartea*, *Cyathostemon* and most other capsular members of the tribe Chamelaucieae, the style base is inserted into a long tubular depression reaching down to the level of the placentas. An interesting feature of the gynoecium in *Seorsus* is the shallowness of the depression in the disc, resulting in a distinct gap between the base of the style and the area of attachment of the placentas to the central axis of the ovary. This gap is filled with a relatively soft tissue and is longer in *S. clavifolius* than in the other three species of *Seorsus*. All species of *Hypocalymma* have a 2–4-locular ovary and most have the style base deeply inset. However, some *Hypocalymma* species have an unusual modification in which the style base is not inserted at all but instead enlarges at its base and grades into the top of the ovary.

Stigma. At maturity the stigma in *Seorsus* is peltate, with that of *S. taxifolius* quite large and the others smaller. There is a tendency for *Astartea* to have large peltate stigmas and *Hypocalymma* and *Cyathostemon* to have capitate stigmas, but there are exceptions.

Fruit. In *Seorsus*, the fruit is a 2- or 3-valved capsule with quite thin walls. It is largely inferior, being fused to the hypanthium for about two-thirds to three-quarters of its length. In contrast, in *Astartea* the capsule is about half inferior and in most *Cyathostemon* and *Hypocalymma* species the capsule is largely superior. However, the species of *Cyathostemon* currently known as *Astartea heteranthera* C.A.Gardner has its fruit about half inferior.

The outer wall of the capsule (including the hypanthium) and the valves of many *Astartea* species are similar in texture to those of *Seorsus* species. In contrast, a thicker harder wall and valves are found in *Cyathostemon* and most *Hypocalymma* species, and there is some tendency in *Astartea* for thick walls and valves to develop too, especially in the group related to *A. aspera*.

Seeds. Like the related genera *Astartea*, *Cyathostemon* and *Hypocalymma*, *Seorsus* species have a crustaceous testa, a feature found in all members of the tribe Chamelaucieae that have a dehiscent fruit. In this tribe, crustaceous seeds vary from having a continuously curved shape, such as reniform or ovoid, to being highly angular in shape with distinct facets. The term facet is used here to describe flattened or curved parts of the testa surface separated from other parts of the testa by a definite angle.

Seorsus has seeds that are distinctly facetted, with the base (i.e. the part adjacent to the central axis of the fruit) larger than the distal end. Usually, each seed has five facets, the largest of which is its rounded back which curves strongly at the base. There are also two equal-sized flat facets forming its sides (the surfaces that abut adjoining seeds) and two much shorter and narrower facets to the inside. One of the small inner facets (the basal one) abuts the placenta and includes a small hilum, while the distal one abuts the seed that is attached to the opposite side of the placenta. The distal inner facet is usually narrower than the basal one and is sometimes reduced to a rounded edge so that the seed has only four facets. The position of the hilum on the basal inner facet varies from almost terminal to about half way down its length.

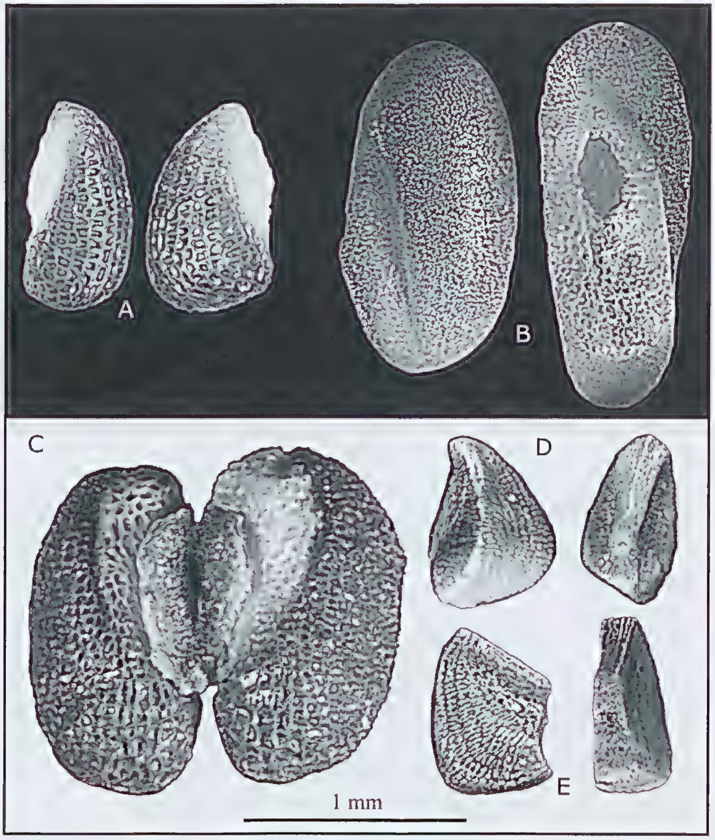

Figure 3. A – lateral view of seeds from *Astartea aspera*; B – lateral and adaxial views of seeds from the *Cyathostemon* species that is currently known as *Astartea heteranthera*; C – lateral view of two seeds, still attached to their placentas, from *Hypocalymma angustifolium* (Endl.) Schauer; D – oblique and adaxial views of seeds from *Seorsus aequatorius*; E – lateral and adaxial views of seeds from *Seorsus intratropicus*. Digital images prepared by Alex Williams from *B.E. Hall* 30a (A), *B.L. Rye* 239099 *& M.E. Trudgen* (B), *B.L. Rye* 241206, *F. Hort & J. Hort* (C), *H. Hallier* 2308 (D) and *P.K. Latz* 10117 (E).

The three tropical species have similar seeds with an obtuse angle on the inside formed by two narrow, more or less flat inner facets or with the basal facet slightly incurved (Figure 3D & E). The seeds of the fourth species, *Seorsus clavifolius* from south-western Australia, differ in that the inner facet abutting the placenta is more deeply incurved (Figure 2E). The angular seeds of *Seorsus* differ markedly from those of *Astartea*, *Cyathostemon* and *Hypocalymma*, in which the outer surface grades into the sides gradually rather than being separated by sharp angles (Figure 3A–C). These three genera all show further differences from *Seorsus* in their seeds, in characters such as seed size, orientation in the locule and testa thickness and ornamentation, some of which are listed in Table 1.

All four genera have a modified region on the inner part of the seed, which may have been formed by a down-turning and fusion of the narrow end of the seed onto the main part of the seed. The embryo, like the cavity in which it is contained, is restricted to the main part of the seed and is narrowest at the end where the modified region originates. The size and distinctness of the modified area varies, often even on seeds from the same fruit. It can have a distinctive colour (Figure 3A & C) or be similar in colour to the remainder of the seed (Figure 3B). In some species, such as *Astartea* sp. Mt Johnson (A.R. Annels 5645), this area has evolved to function as a "soft fleshy elaiosome" (Hutchison 1997: 36, fig. 9a). In other species it may have different functions, perhaps sometimes acting as a false elaiosome. In taxa where it is very reduced, sometimes to the point of being apparently absent as in *Seorsus clavifolius*, it may now be redundant.

On seeds of the three tropical species of *Seorsus*, the modified area includes the distal inner facet and is visible from side view, comprising cells that are aligned parallel to the facet and more or less at right angles to those of the main part of the seed (Figure 3D & E). The distinct area of cells forming the upper facet is not present in the south-western Australian species, *S. clavifolius* (Figure 2E), although on some seeds there are small areas where the cells have a somewhat similar alignment. However, when seeds of this species are cut parallel to the sides, the top can be clearly seen to have turned down as in other species of *Seorsus*.

Chaff. In *Seorsus* the unfertilised ovules or aborted seeds, also known as chaff, may look very similar to the fully developed seeds or they may be similar but distinctly narrower. For example, in one 2-locular fruit examined of *S. clavifolius* there were 16 apparent seeds, eight in each loculus, but only two from each loculus were found to be true seeds when cut open. The 14 pieces of chaff tended to have a thicker crustaceous wall but much less content than the seeds, with the enclosed material of a drier, somewhat harder, texture and somewhat darker that the soft white tissue inside the seeds. In contrast, in *Astartea*, *Cyathostemon* and *Hypocalymma* the chaff are quite different from the seeds, at least in size, and often also much softer and a different colour.

Distinction and affinities of *Seorsus*

The morphological and molecular evidence discussed above indicates that *Seorsus* is related to *Astartea*, *Cyathostemon* and *Hypocalymma*. Both *Cyathostemon* and *Hypocalymma* are readily distinguished from *Seorsus* by the way their stamens are arranged, as well as by a variety of vegetative, inflorescence, anther, fruit and seed characters. *Astartea* shows the greatest similarity in morphology to *Seorsus*, being the only other member of the tribe Chamelaucieae in which well-defined antisepalous stamen fascicles occur. Other characters the two genera share include the occurrence of a marked lignotuberous habit (although not universal in either genus), solitary axillary flowers with the pedicels varying from absent to about the same length as the peduncles, stamens with the filament attached at or near the base of the connective, similar seed size and the presence of a modified area on the inner surface of the seeds.

This leaves the question of whether or not *Seorsus* shows sufficient morphological differences from *Astartea* to justify its recognition as a distinct genus. To summarize the main differences outlined in the previous section, *Seorsus* differs from *Astartea* in:

- the breaking down of the sub-epidermal tissue of the young shoots by multiple transverse fissures;
- lacking clustering of the leaves into fascicles;
- the lack of processes adjacent to the claw of the petals;
- the shape of the anther connective;
- the orientation of the anther loculi on the connective;
- the distinct separation of the style base from the placentas;
- having a greater proportion of the fruit inferior;
- having strongly facetted seeds;
- the chaff being quite similar in appearance and texture to the seeds.

We believe that the seed and anther differences alone are sufficient to justify the erection of *Seorsus*, with the stem tissue type, leaf arrangement, style base position and degree of inferiority of the fruit also being significant characters distinguishing the two genera. The particular combination of anther characters found in *Seorsus* is sufficient for anther type to be used alone to identify this genus from all other members of the Chamelaucieae.

Recognition of the genus *Seorsus* is also supported by the molecular data, as discussed earlier. *Seorsus* and *Astartea* also differ in their distributions and habitat preferences as outlined below.

Distribution and habitat

The current geographic range of *Seorsus*, extending for about 4,000 km from Borneo to southern Australia (Figure 4A), is far greater than that of the related three genera *Astartea*, *Cyathostemon* and *Hypocalymma*, all of which are restricted to south-western Australia. In fact, the only genus within the entire tribe Chamelaucieae found over a greater distance is *Baeckea s. str.*, which extends from southern China to Tasmania.

Although *Seorsus* is a widespread genus, each of its four species is only known from a very small area and each of these areas is well separated. The disjunction between the two Australian species is about 2400 km and the distance between the localities of the two species in Borneo is over 600 km. Both of the latter species occur on mountains. *Seorsus taxifolius* occurs at high altitudes (over 2000 m) on the rocky slopes of the sandstone mountain Mt Murud, while *S. aequatorius* occurs on a relatively isolated mountain, Mt Kelam, with a bald broad granite summit less than half as high as Mt Murud. One of the Australian species, *S. intratropicus*, also has a rocky habitat in the tropics, but at lower altitudes, occurring in cracks in sandstone pavements in the north of the Northern Territory.

The other Australian species, *Seorsus clavifolius*, occurs in a temperate rather than tropical climate, in sandy soils on the margins of salt lakes in the south-west of Western Australia. It occurs within the regions occupied by both *Cyathostemon* and *Hypocalymma* but just outside the known range of

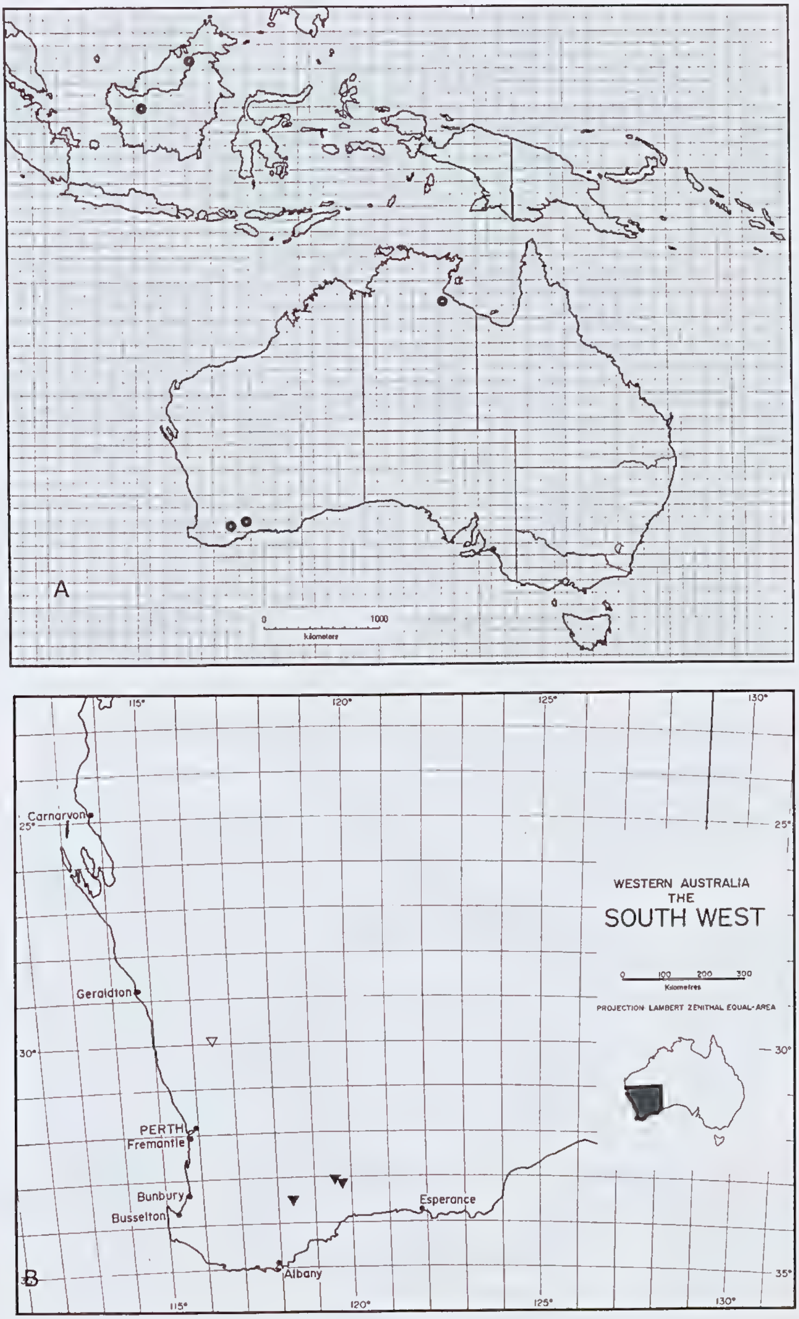

Figure 4. Distribution maps. A – the genus *Seorsus*; B – *Seorsus clavifolius* (▼), with the apparently inaccurate type locality (▽).

Astartea. Its habitat on the margins of salt lakes also differs from that of *Astartea*, which occurs in habitats associated with fresh water.

About half of Borneo appears to have been derived from four blocks originating from Gondwana, with a much smaller portion derived from two blocks from Indochina, and the rest of more recent origin, although when and how the amalgamation of the various parts took place are far from certain (Michaux 1991). Mt Kelam, the granitic mountain where *Seorsus aequatorius* occurs, is on by far the largest of the Gondwanan blocks. Mt Murud, on which *S. taxifolius* grows, does not appear to be of Gondwanan origin; however it is situated not far from a small block thought to have originally been located between what are now Western Australia and India.

Given the distribution of the genus in areas that were once part of Gondwana and the small and very widely separated areas of occurrence of the four species, it seems appropriate to consider *Seorsus* to be a relictual genus with a history predating the break-up of Gondwana. Major disjunctions occur within Australia in a few genera of tribe Chamelaucieae, and one genus, *Sannantha* Peter G.Wilson (Wilson *et al.* 2007), is disjunct between the eastern coast of Australia and New Caledonia. However, in no cases are these disjunctions as great as the distance separating the two Australian species of *Seorsus*.

Key to *Seorsus* and related taxa

1. Young stems with thick sub-epidermal tissue that becomes transversely fissured before being shed. Anther loculi close at the apex but very divergent at the base; connective triangular, with a wide basal attachment. Seeds strongly facetted .... **Seorsus**

1: Young stems usually with outer tissue shed in longitudinal strips or in patches. Anther loculi more or less parallel; connective not much broader at the base than at the top. Seeds not facetted or with facets poorly developed

  2. Stamens 8–30, united into an undulating or fairly level petaline ring (the leaves always opposite-decussate). Embryo (and the seed cavity containing it) broadest towards the apex of the fruit .... **Cyathostemon**

  2: Stamens 3–125 in varied arrangements (if androecium as above then leaves in whorls of three). Embryo and seed cavity broadest towards the base or lateral margins of the fruit loculi

    3. Leaves tending to be fasciculate and always narrow. Stamens 3–60, when very few then all or mostly widely spaced, when more numerous then all or mostly in antisepalous fascicles. Seeds 0.5–1.3 mm long, thin-walled in most species .... **Astartea**

    3: Leaves narrow or broad but never fasciculate. Stamens 10–125, basally united into a continuous circle or, when few, sometimes with gaps present. Seeds 0.8–2.3 mm long, thick-walled .... **Hypocalymma**

Descriptions

Seorsus Rye & Trudgen, *gen. nov.*

Frutices glabri. Folia opposita, decussata, parvula. Flores solitarii in axillis foliorum positi. Sepala 5, in fructu persistentia. Petala 5, ungue basali brevi. Androecium ex staminibus in fasciculo antisepalum; antherae basifixae, cellulis basaliter divergentibus, longitudinaliter dehiscentibus, connectivo ad basim latissimo, glande adaxiali. Ovarium 2- vel 3-loculare, loculis 6–16-ovulatis; placentae axiales, peltatae. Styli basis in depressione inserta. Fructus siccus, 2- vel 3-valvatus. Semina crustacea, faceta.

Typus: *Seorsus clavifolius* (C.A.Gardner) Rye & Trudgen.

Shrubs prostrate or erect and up to *c.* 1.7 m high, often widely spreading, glabrous; branchlets with each petiole borne at the summit of a swelling, with a smooth pale grey epidermis covering a thick transversely fissured layer. *Leaves* opposite and decussate, spreading, small, entire, shortly or very shortly petiolate; lamina obovate or oblong-elliptic to almost linear, thick, dotted with small oil glands. *Inflorescence* of solitary axillary flowers, usually with few but sometimes up to 12 flowers per branchlet. *Peduncles* short, straight, with two opposite bracteoles at the summit. *Bracteoles* usually persistent, leaf-like or with a herbaceous keel and more scarious margins, the margins somewhat to very incurved. *Pedicels* short or absent. *Buds* more or less truncate. *Flowers* predominantly 5-merous, occasionally 6-merous, white or creamy white, sometimes with a slight pink flush, protandrous. *Hypanthium* with an obconic or broadly obconic adnate part and more spreading free part; adnate part with a coarse and irregular reticulate-rugose patterning; free part less prominently patterned and shorter than adnate part. *Sepals* usually 5, fairly erect in flower, persistent in fruit, depressed ovate to semicircular, with an incurved herbaceous keel which is smooth to distinctly ridged or shortly horned dorsally, the margin somewhat scarious. *Petals* usually 5, widely spreading, not persistent in fruit, broadly obovate to circular, broadly clawed at base. *Androecium* of 15–78 stamens, in distinct fascicles of 2–18 stamens opposite the sepals, the filaments united into a long compressed claw within the gap between the petal claws, with the longest stamens of each fascicle closest to the petals and shortest ones on the inside; staminodes and processes absent. *Stamens* shorter than the petals and exceeded by the stigma when the style is mature, curved inwards, the free portion terete. *Anthers* with a broadly triangular connective, not versatile, with latrorse loculi that are well separated at the base but more or less meet at the apex; loculi broadly elliptic from top view, longitudinally dehiscent; connective gland large, more or less globular, located to the inner surface of the connective facing inwards towards style. *Disc* level around a slightly raised centre, dotted with oil-glands. *Ovary* inferior, adnate to hypanthium for its full length in flower but expanding above base of the free hypanthium in fruit, 2- or 3-locular; placentas axile, attached above centre of ovary, large, either flattened and very broadly attached or conic and peltate with a central very short stalk, without a longitudinal slit between the ovules; ovules 6–16 per loculus, usually variable in number between loculi, either radially arranged and all meeting at centre of placenta or arranged in two closely meeting rows along the length of the placenta and with ovules radiating at each end connecting the rows. *Style* narrowly cylindric, base inserted in a short depression; stigma peltate, flattened, disc-like, more or less circular from top view. *Fruit* a 2- or 3-valvate capsule, largely inferior, rather thin-walled, soft and leathery-succulent at first, becoming more crustaceous, several–many-seeded, with valves becoming erect but not opening very widely; hypanthium cup-shaped to broadly 2-lobed; disc broad and horizontal, with summit of each locule slightly to prominently raised; inner wall thin, with a faint reticulate pattern of cells, shiny. *Seeds* several to many per cell, broadest towards the base, 4- or 5-facetted, the facets consisting of a long and broad rounded outer surface, two large lateral surfaces and 1 or 2 narrow inner surfaces; testa straw-coloured to medium brown, somewhat shiny, with a reticulate pattern of numerous rows of minute cells or colliculate; hilum small, more or less central or above the centre of basal inner facet. *Chaff pieces* (abortive seeds and/or unfertilised ovules) with a crustaceous testa, facetted, sometimes difficult to distinguish from the seeds.

Etymology. From the Latin *seorsus* – severed or apart, referring to the great disjunctions in this genus, with each species separated from each of the others by distances varying from 600 to 4000 km.

Key to species of *Seorsus*

1. Stamens 10–18 per fascicle. Ovules 12–16 per loculus. Occurring in the Roper River area, Northern Territory .... **S. intratropicus**

1: Stamens 2–6 per fascicle. Ovules 5–9 per loculus. Occurring in south-western Australia or Borneo.

  2. Leaves very broadly elliptic to narrowly obovate, 2–3.5 mm long. Peduncles 0.9–2 mm long; pedicels 1–2 mm long. Ovary 2-locular in all or most flowers. Occurring in the Lake King area, Western Australia .... **S. clavifolius**

  2: Leaves very narrowly obovate to linear in outline, 4–8 mm long. Peduncles 0.4–1 mm long; pedicels absent. Ovary 3-locular in all or most flowers. Occurring in Borneo

    3. Sepals horned. Stamens mostly 3 per fascicle. Occurring in northern Sarawak, Malaysia .. **S. taxifolius**

    3: Sepals not horned. Stamens mostly 6 per fascicle. Occurring in West Kalimantan, Indonesia .... **S. aequatorius**

Seorsus aequatorius Rye & Trudgen, *sp. nov.*

Seorso taxifolio affinis sed sepalis integris (non cornutis) et staminibus plus numerosis differt.

Typus: Gunung Klam [Mt Kelam, West Kalimantan], Borneo, 1893–1894, *P. Hallier* 2300 (*holo*: L 0651485).

Shrub height unknown; young branchlets leafy, with prominent bands of pale grey epidermis not much wider than the petioles they subtend. *Leaves* mostly widely spreading, dense on young shoots. *Petioles* 0.7–1 mm long, poorly defined. *Leaf blades* very narrowly obovate to linear in outline, 4–6 mm long, 0.5–0.7 mm wide, *c.* 0.5 mm thick, obtuse, adaxial surface deeply convex, abaxial surface furrowed, with oil glands inconspicuous. *Peduncles* 0.6–0.8 mm long. *Bracteoles* probably persistent, leaf-like but smaller than leaves, *c.* 2.2 mm long. *Pedicels* absent. *Flowers* not seen fully open. *Hypanthium* *c.* 1.8 mm long. *Sepals* depressed-ovate, 0.6–1 mm long, with midrib smooth or somewhat ridged but not horned; margin petaline, denticulate. *Petals* broadly obovate, *c.* 2.3 mm long, white. *Androecium* of 28–30 stamens, with (5)6 stamens per fascicle; fascicles commonly 0.5–0.7 mm wide at base, the outermost filaments *c.* 1 mm long. *Anthers* *c.* 0.25 mm long, *c.* 0.4 mm wide. *Ovary* 3-locular; ovules 6–8 per loculus. *Style* not seen at maturity. *Fruit* 2/3–3/4-inferior, *c.* 2 mm long, 2.5–3 mm diam.; placentas ± elliptic from top view, *c.* 0.35 mm across. *Seeds* *c.* 0.7 mm long, *c.* 0.5 mm wide, *c.* 0.5 mm deep, medium brown, with a small modified region on the inner surface with narrowly oblong cells; testa with longitudinal rows of many transversely narrowly oblong cells. *Chaff pieces* more numerous than the fully developed seeds, similar in shape but somewhat smaller. (Figures 1B & 3D)

Distribution and habitat. This Indonesian species is recorded from Mt Kelam, a granite mountain just over 1000 m high in the West Kalimantan region (Kalimantan Barat) of south-western Borneo. The type specimen is labelled Gunung 'Klam', with *gunung* being the Malaysian and Indonesian word for mountain. Apparently the name of this mountain should be written as Kelam but may be pronounced Klam (Gerald Thijsse pers. comm., who confirmed that this collection comes from Mt Kelam). No habitat details are given on the specimen, but the species is likely to occur in a rocky habitat with too little soil to support rainforest.

Phenology. Flowering and fruiting period unknown.

Conservation status. The conservation status of this species needs to be investigated, as it is known only from a very old collection on Mt Kelam. Being fairly isolated from other mountains in Borneo, Mt Kelam is likely to have a suite of endemic species, one of which is the critically endangered carnivorous plant *Nepenthes clipeata* Danser. *Seorsus aequabilis* is likely to be rare, and may be critically endangered or even extinct.

Etymology. Since the only known locality of *Seorsus aequatorius* is very close to the Equator, its specific epithet is based on the Latin word meaning equatorial.

Affinities. Closely related to *Seorsus taxifolius*, differing in its more numerous stamens and its thinner sepals without a horn. A less obvious difference is in the young stems. In *S. taxifolius* the leaves are each subtended by a patch of pale grey epidermis that is much wider than the petiole, and the tissue below has very obvious transverse fissures (Figure 1C) whereas *S. aequatorius* has pale grey strips that are not much wider than the petiole and narrower fissures in the sub-epidermal tissue (Figure 1B). These clear morphological differences, combined with the different location and habitat of the taxon, indicate that it should be treated as a distinct species rather than just a subspecies.

Notes. As there was only one specimen available, in a fairly poor condition with most of its leaves and all of the flowers and fruits in packets rather than attached to the stems, not all characters could be described for this species. Most of the fruits had already opened fully and shed all their seeds but one intact loculus was found to contain eight facetted pieces, all well developed but only the largest one probably a viable seed, all or at least six of the other pieces apparently being chaff.

Seorsus clavifolius (C.A.Gardner) Rye & Trudgen, *comb. nov.*

Astartea clavifolia C.A.Gardner, *J. Roy. Soc. Western Australia* 27: 188 (1942). *Type*: south of Maya, Western Australia, 21 September 1931, *C.A. Gardner* 2704 (*holo*: PERTH 01605062; *iso*: PERTH 01605054, 01605070, 01605089).

Illustrations. Blackall & Grieve (1980: 88), as *Astartea clavifolia*; Gardner's pencil sketch on the isotype PERTH 01605054.

Shrub dense, 0.6–1.4 m high, up to 2 m wide, multi-stemmed at base from a below-ground lignotuber, often with 20–40 stems arising from ground level; young branchlets leafy, more or less terete, with the pale grey epidermis retained longest on the swelling below each petiole. *Leaves* mostly on short branchlets, fairly dense. *Petioles* well defined, 0.3–0.6 mm long. *Leaf blades* very broadly elliptic to narrowly obovate, 2–3.5 mm long, 0.9–1.6 mm wide, 0.4–0.7 mm thick, adaxial surface flat or shallowly concave, abaxial surface convex or with a furrow along the midrib, sometimes rugose with prominent oil glands; apex obtuse or almost truncate, not or scarcely mucronulate. *Peduncles* usually at 1–6 nodes towards ends of branchlets, 0.9–2 mm long. *Bracteoles* often persistent in fruit, 0.7–1.3 mm long, 0.4–0.7 mm wide, with apex hooded, reddish. *Pedicels* 1–2 mm long. *Flowers* 7–10 mm diam., sometimes with a slight pink flush. *Hypanthium* 1.8–2.5 mm long. *Sepals* mostly broadly ovate, 0.9–1.6 mm long, 1.5–2.3 mm wide, often reddish outside, herbaceous midrib smooth to distinctly ribbed dorsally. *Petals* 3–4 mm long, white or possibly sometimes pale pink. *Androecium* of 17–23 stamens, in fascicles of 2–6 (most commonly 4), exceeding sepals; fascicles *c.* 0.5 mm wide at base, the longest filaments 1–1.6 mm long. *Anthers* 0.3–0.4 mm long, 0.5–0.8 mm wide. *Ovary* 2(3)-locular; placenta almost conic, with a central attachment; ovules 6–9 per loculus, radially arranged and all meeting at the centre of the placenta. *Style* 1.3–1.7 mm long, dark red, base separated by 0.6–0.8 mm from placentas; stigma 0.2–0.3 mm diam. *Fruit c.* 2/3 inferior, somewhat compressed when 2-locular, hemispheric when 3-locular, 2.2–3 mm long, 3–3.5 mm x *c.* 2 mm across or rarely 3–3.5 diam.; hypanthium green and reticulately pitted in adnate part, dark red-brown and smooth distally; disc flat except for the 2(3) slightly raised valves; placentas extending into the loculus for 0.4–0.6 mm but only *c.* 0.4 mm diam. *Seeds* 1.2–1.4 mm long, 0.6–0.8 mm wide, 0.6–0.9 mm deep, without an obvious modified region on the inner surface, the hilum near centre of basal inner facet; testa medium brown, minutely and shallowly colliculate. *Chaff pieces* similar to the seeds but tending to be narrower and often with somewhat sunken facets. (Figure 2A–E)

Other specimens examined. WESTERN AUSTRALIA: Chinocup Nature Reserve, 16 Nov. 1992, *A. Coates* 3731 (PERTH); W shore of Lake King, *c.* 500 m N or road, 11 Dec. 2003, *J.A. Cochrane* 4838 (K, PERTH); 2.3 km E of Lake Chinocup Rd on old track into nature reserve, 2 Feb. 2004, *J.A. Cochrane* 4961 (PERTH); Lake King Nature Reserve, 19 Oct. 1995, *R.J. Cranfield* 10600 (MEL, PERTH); Chinocup, 11 Oct. 1999, *R. Cugley* 95 (PERTH); N side of Rasmussen Rd, 11 Sep. 2000, *R. Cugley* 127 (L, PERTH, UC); 8 miles [13 km] W of Lake King, 31 Oct. 1965, *K.R. Newbey* 1906 (PERTH); 2.3 km E of Chinocup Rd on track that originates 350 m S of Sutherland track, 26 Oct. 1997, *D. Papenfus* 708 (PERTH); N of Lake King–Newdegate road on track 12.8 km W of Lake King, 29 Oct. 1997, *D. Papenfus* 716 *& K. Macey* (PERTH); Allen Rd, 1.2 km E of Newdegate–Ravensthorpe road, *c.* 13 km S of Lake King, 29 Oct. 1997, *D. Papenfus* 721 *& K. Macey* (PERTH); 0.8 km N of Newdegate–Ravensthorpe road on a track that starts not far from western edge of Lake King salt lake, *B.L. Rye* 250109 *& M.E. Trudgen* (BRI, PERTH); 2.3 km E of Chinocup Rd on a track that starts *c.* 0.35 km S of Sutherland Rd, 13 Jan. 2005, *B.L. Rye* 250119 *& M.E. Trudgen* (CANB, PERTH); 2.3 km E of Chinocup Rd on a track that starts *c.* 0.35 km S of Sutherland Rd, 13 Jan. 2005, *B.L. Rye* 250120 *& M.E. Trudgen* (AD, PERTH); W end of Lake King salt lake, 17 Oct. 1997, *Peter G. Wilson & N. Lam* UNSW23727 (NSW).

Distribution and habitat. Endemic to the South West Botanical Province, occurring on the sandy margins of salt lakes (commonly 1–1.5 m above level of lake) or on raised islands within them in the Pingrup to Lake King area. Most records are from *Melaleuca* high shrubland, with one record from *Eucalyptus angustissima* subsp. *quaerenda* open mallee over heath. Below the *Melaleuca* layer, *Seorsus* may form a closed or open shrubland, and other genera commonly present are *Darwinia*, *Leucopogon* and *Lepidosperma*. (Figure 4B)

Phenology. Flowering has been recorded from September to November. Mature fruits were present on specimens collected from late October to January.

Conservation status. Conservation Codes for Western Australian Flora: Priority Two. This species is common at several localities, but one of these sites appears to be being mined for gypsum. Seeds have been deposited in the Millennium Seed Bank.

Affinities. This very distinctive species is readily distinguished from the other members of its genus by its broader shorter leaves with a very well defined petiole, its usually 2-locular ovary, and its habitat on the margins of salt lakes. It is possibly the only lignotuberous species in the genus and it has the longest pedicels and largest seeds.

Notes. Multiple, well-separated stems are produced from the lignotuber, and there is commonly a mound built up over the base of the plant. Young plants may have only a few stems but older ones commonly have 20–40 stems at ground level. Insect damage to the leaves is common on some specimens, with a variety of scale insects observed, and one specimen (*Peter G. Wilson & N. Lam* UNSW23727) also has rounded grey galls *c.* 2.5 mm long terminating some of its branchlets.

All recent flowering collections of this species have been from the margins of salt lakes near Pingrup and Lake King in late October and November. Gardner made collections with Blackall (numbers 1371 etc.) from between Lake Carmody and Lake Biddy on 19 November 1931 and others on his own (numbers 2929–2933) from the vicinity of Lake King on 24 November 1931. Perhaps some mix up with the numbering of his specimens resulted in the type specimen of *Seorsus clavifolius* being given an incorrect locality and date. However, the name *Astartea clavifolia* was entered into Gardner's field notebook and the descriptive details given for the plant appear to tally with this species. According to the field notes, the locality was south of Maya in yellow sand in a thicket of *Melaleuca uncinata*. If the Maya locality is correct, then there is a large disjunction of over 400 km in the known range of *S. clavifolius*. This would make the generic name, chosen in reference to the disjunction of its members, even more appropriate. However, the different habitat type recorded suggests that the Maya record is in error.

Gardner (1942: 188) observed that his new species differed from the type species of *Astartea* in having "much shorter and broader clavate leaves which are never clustered" and in its 2-locular ovary. Probably fooled by the strange orientation and separation of the loculi on each anther, he gave the stamen number per fascicle as *c.* 8, apparently counting each loculus as a stamen. Actually, the fascicles on the holotype commonly have 4 stamens. Occasional 6-merous flowers have been observed, which may have more than the usual number of stamens per flower since there is an extra fascicle of them.

Seorsus intratropicus (F.Muell.) Rye & Trudgen, *comb. nov.*

Astartea intratropica F.Muell., *Fragm.* 1: 83 (1859). – *Baeckea intratropica* (F.Muell.) Nied. in A. Engler & K. Prantl, *Nat. Pflanzenfam.* III: 7, 99. (1893). *Type citation*: In clivis rupestribus passim irregius et circum fontes prope origenem fluviorum Limmen-bight et Roper River. *Type*: rocky cliffs and springs near the origins of Limmen Bight River and Roper River, [Northern Territory], *F. Mueller s.n.* (*holo*: MEL *n.v.*).

Erect spreading *shrub*, 1–1.7(3) m tall; young branchlets leafy, somewhat compressed at right angles to the orientation of the pair of leaves directly above, with prominent bands of pale grey epidermis below each petiole. *Leaves* antrorse to widely spreading, dense on young shoots, soon shed. *Petioles* 0.6–0.9 mm long, often poorly defined. *Leaf blades* very narrowly obovate in outline, 6–8.5 mm long, 0.5–0.8 mm wide, 0.8–1 mm thick, obtuse, adaxial surface very deeply convex, abaxial surface furrowed, with scattered moderately large oil glands. *Peduncles* at 1–8 nodes towards the end of each branchlet, 1.0–1.2 mm long. *Bracteoles* apparently deciduous, *c.* 1.5 mm long, *c.* 0.6 mm wide. *Pedicels* 0.4–0.6 mm long, 5-ribbed. *Flowers* 6–7.5 mm diam. *Hypanthium* 1.9–2.5 mm long. *Disc* minutely dotted with prominent white glands. *Sepals* depressed to broadly ovate, 1.0–1.2 mm long, 1.5–1.6 mm wide, erect, dorsally ridged on midrib, possibly somewhat reddish outside. *Petals* broadly obovate, 2.3–3 mm long, creamy white. *Androecium* of usually 57–70 stamens but up to 78 recorded, with 10–15(18) stamens per fascicle; fascicles *c.* 1 mm wide at base, the filaments connate for half or more of their length and up to 2 mm long. *Anthers c.* 0.2 mm long, *c.* 0.4 mm wide. *Ovary* 3-locular; placenta broadly elliptic with marginal small circular attachment points for the ovules, flat, very broadly attached by an oval hollow structure; ovules 12–16 per loculus. *Style* 1.4–1.8 mm long, base separated by 0.4–0.5 mm from the placentas; stigma *c.* 0.3 mm diam. *Fruit* 2/3–3/4 inferior, *c.* 2.5 mm long, *c.* 2.5 mm diam.; hypanthium cup-shaped; disc flat around the margin, somewhat raised in centre into 3 valves, conspicuously dotted with minute white oil glands; placentas elliptic

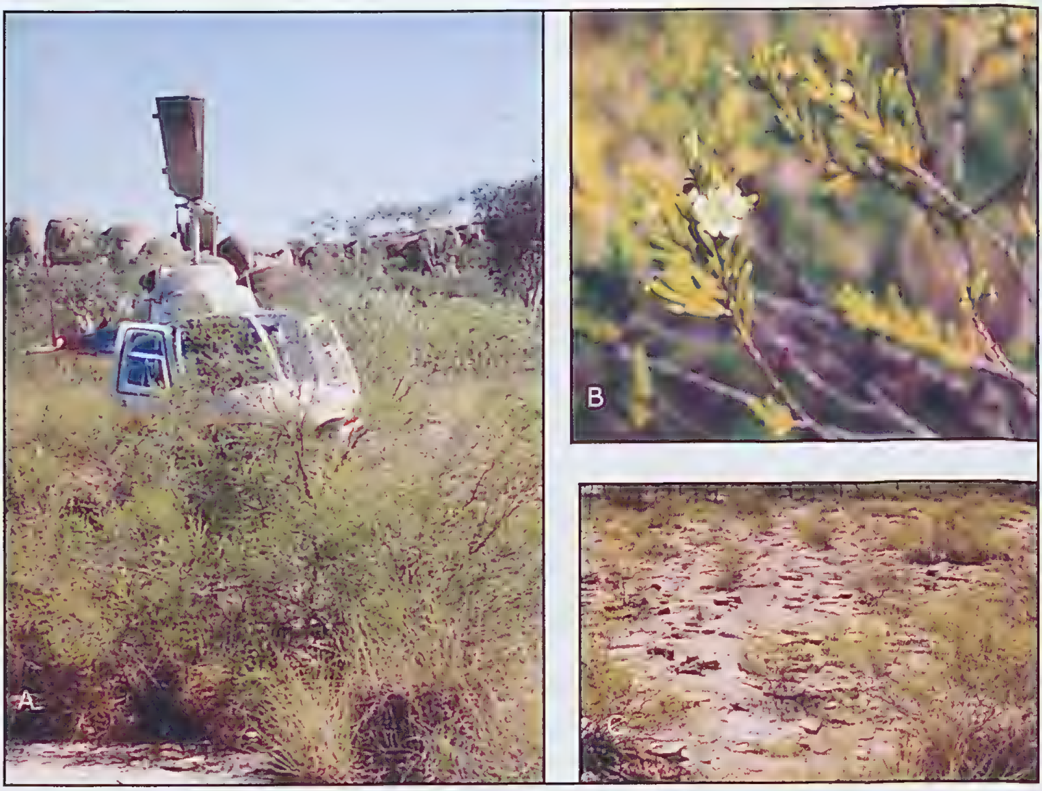

Figure 5. *Seorsus intratropicus*, photographs by Andrew Mitchell (voucher *A.A. Mitchell* 7017). A – plant habit; B – flowering stem; C – habitat.

with acute ends, *c.* 0.7 mm long, *c.* 0.35 mm wide, *c.* 0.15 mm thick. *Seeds* laterally compressed, 0.8–0.9 mm long, *c.* 0.35 mm wide, 0.6–0.7 mm deep, the basal and distal inner facets roughly equal and the hilum above the middle of the basal inner facet, with a large modified region on the inner surface that is more or less triangular from side view and has narrowly oblong cells; testa pale yellowish brown, with longitudinal rows of many transversely oblong cells. *Chaff pieces* probably numerous, similar in appearance to seeds except that they tend to be only *c.* 0.2 mm wide, with the crustaceous wall similar to or thicker than that of the seeds (Figures 2F–I, 3E & 5)

Specimens examined. NORTHERN TERRITORY. *c.* 40 km SSW of the Natham River Homestead, 27 Aug. 1985, *P.K. Latz* 10117 (NSW, PERTH); 3 km S of Limmen Gate, S of Roper Bar, Bohemia Downs Station, 14 Sep. 1995, *P.K. Latz* 14564 (NSW); near Limmen Gate, S of Roper Bar, Bohemia Downs Station, 23 Aug. 2001, *A.A. Mitchell* 7017 (NSW).

Distribution and habitat. Endemic to the Limmen Bight region of Northern Territory, recorded from near Limmen Gate on Bohemia Downs Station. *Astartea intratropica* grows in cracks on sandstone blocks and has recently been recorded as the dominant species in this restricted habitat. Mueller (1859) described the habitat as wet rocky slopes and around springs and Bentham (1867: 91) described it as 'ravines of the sandstone table-land'.

Phenology. Flowers and fruits recorded from late August to mid-September.

Conservation status. This taxon is known either from just one locality or a few collections in close proximity. It was reported as being fairly common in 2001 at a location on a pastoral station.

Affinities. Readily distinguished from all other species of *Seorsus* by its more numerous stamens and ovules. In its leaf morphology it is similar to the two species in Borneo but it is like the Australian species *S. clavifolius* in having variable stamen numbers per fascicle. It is intermediate between the south-western and Borneo species in its pedicel length.

Notes. This description is based primarily on the single specimen located in PERTH, although the NSW specimens examined appeared to be very similar in their morphology. *Seorsus intratropicus* is probably not lignotuberous, but its rocky habitat presumably gives it significant protection from fires.

Seorsus taxifolius (Merr.) Rye & Trudgen, *comb. nov.*

Baeckea taxifolia Merr., *Sarawak Mus. J.* 3: 534, 537 (1928). – *Babingtonia taxifolia* (Mer.) A.R Bean, *Austrobaileya* 4: 632 (1997). *Type*: Mt Murud, Borneo, October 1922, *E. Mjöberg* 111 (*lecto*: UC; *isolecto*: BM 000028875 *n.v.* image seen, K 000349801 *n.v.* image seen).

Prostrate to erect *shrub*, up to 1.3 m tall; young branchlets leafy, with the prominent regions of pale grey epidermis much wider than petioles they subtend. *Leaves* mostly widely spreading, dense on young shoots, soon shed. *Petioles* 1–1.5 mm long, poorly defined. *Leaf blades* very narrowly obovate to linear in outline, 5–8 mm long, 0.5–0.8 mm wide, 0.4–0.7 mm thick, obtuse, adaxial surface deeply convex, abaxial surface furrowed, with oil glands inconspicuous. *Peduncles* at 1–3 nodes towards the end of each branchlet, 0.4–1 mm long. *Bracteoles* persistent, leaf-like but smaller than leaves, commonly *c.* 3 mm long. *Pedicels* absent. *Flowers c.* 6 mm diam. *Hypanthium* 1.5–2 mm long. *Sepals* depressed ovate, 0.8–1.1 mm long, with midrib thickened and protruding in a short horn *c.* 0.3 mm long. *Petals* broadly obovate, *c.* 2 mm long, white. *Androecium* normally of 15 stamens, with 3 stamens per fascicle; fascicles *c.* 0.4 mm wide at base; outermost filaments *c.* 1.3 mm long. *Anthers c.* 0.2 mm long, *c.* 0.4 mm wide. *Ovary* 3-locular; placenta broadly elliptic with marginal small circular attachment points for the ovules, flat, very broadly attached by an oval hollow structure; ovules 6 or 7 per loculus. *Style* 1–1.5 mm long, base separated (in fruit) by *c.* 0.7 mm from the placentas; stigma *c.* 0.3 mm diam. *Fruit* 2/3–3/4-inferior, 1.8–2 mm long, 2.3–3.3 mm diam.; placentas elliptic from top view, moderately thick. *Seeds* 0.6–0.7 mm long, *c.* 0.6 mm wide, *c.* 0.5 mm deep, the basal and distal inner facets roughly equal and the hilum above the middle of the basal inner facet, with a modified region on the inner surface with narrowly oblong cells; testa pale yellowish brown, with longitudinal rows of many transversely narrowly oblong cells. *Chaff pieces* apparently more numerous than the fully developed seeds, more compressed in shape. (Figure 1C)

Specimens examined. SARAWAK, BORNEO: Mt Murud, Oct. 1922, *E. Mjöberg* 84 (UC); altitude 2,200 m, Mt Murud, Kalabit Highlands, 7 Apr. 1970, *H.P. Nooteboom & P. Chai* 0216 (L); altitude 7,000 ft [*c.* 2400 m], Mt Murut, Lawas, 9 Oct. 1967, *I. Paie* S26456 (L).

Distribution and habitat. This species occurs in the Malaysian state of Sarawak, in the northern part of the island of Borneo. It grows on the sandstone mountain, Mt Murud, at altitudes of over 2000 m in open shrublands 'on rocky slopes with little soil'. The name of this mountain is sometimes spelt Murut, as on the *I. Paie* S26456 specimen cited above.

Phenology. Flowers and fruits recorded in early to late October, also recorded in flower in early April.

Conservation status. Apparently endemic to the highest mountain in Sarawak, Mt Murud, which is about 2400 m high and has a summit ridge about four kilometres long. Few major botanical expeditions have been undertaken in this difficult terrain; there was one in 1995 but *Seorsus* was not collected (Beaman 1999).

Affinites. This species can be easily distinguished from other members of its genus by its horned sepals. It also appears to have the largest bracteoles in the genus. See the notes under its closest relative, *Seorsus aequatorius.*

Acknowledgements

This project was supported by three ABRS grants, the first of which resulted in draft descriptions of the two Australian species being prepared by Bronwyn Keighery in 1991. We are grateful to Paul Wilson for the Latin translations, to Peter Wilson for drawing our attention to the species in Borneo and keeping us informed of his unpublished molecular data, to Andrew Mitchell for providing photographs and field information for *Seorsus intratropicus*, to the late Lorraine Cobb for the line illustration, to Alex Williams for the images of stem and seed characters, to Nicholas Lander for providing a map template and to Andrew Crawford for advice on seeds. We thank Juliet Wege for scanning the isolectotypes at BM and K and for checking stamen characters during her appointment as Australian Botanical Liaison Officer, the Chief Collection Manager at L, Gerard Thijsse, for the loan of specimens and information regarding the locality of one of these specimens, the Administrative Curator, Andrew Doran, at UC for the loan of specimens, and to staff at NSW where BLR examined material of *Seorsus*. We also thank the referee, Kevin Thiele and Terry Macfarlane for their helpful comments on the manuscript.

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Tecticornia papillata (Chenopodiaceae: Salicornioideae), a new andromonoecious samphire from near the Carnarvon Range, Western Australia

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Abstract

Shepherd K.A., *Tecticornia papillata* (Chenopodiaceae: Salicornioideae), a new andromonoecious samphire from near the Carnarvon Range, Western Australia. *Nuytsia* 18: 259–266 (2008). *Tecticornia papillata* K.A.Sheph., described here as new, has an unusual fruit structure previously only observed in *T. disarticulata* (Paul G.Wilson) K.A.Sheph. & Paul G.Wilson. It differs from this species in having vegetative articles and bracts with strongly fimbriate margins and caudate apices, and a distinctly papillate epidermis for which the species is named. As this new species has a restricted distribution it has a Priority One conservation status. A distribution map and images of the species are presented. In addition, the molecular and morphological diversity within *T. disarticulata* is discussed.

Introduction

Five species previously included in the genus *Sclerostegia* Paul G.Wilson and the monotypic *Pachycornia* Hook.f. (now all placed in *Tecticornia* Hook.f.; see Shepherd & Wilson 2007) are the only representatives of the subfamily Salicornioideae (Chenopodiaceae) that are andromonoecious. Samphires are typically bisexual, having spike-like inflorescences comprising sessile, 3-flowered cymes arranged in decussate pairs. In the andromonoecious species, each 3-flowered cyme has a bisexual central floret and two male lateral florets. Recent morphological and molecular studies have demonstrated, however, that the genus *Sclerostegia* is not monophyletic and that andromonoecy has evolved independently among the species previously included in that genus (Shepherd 2004; Shepherd *et al.* 2005b; Shepherd & Wilson 2007). *Tecticornia disarticulata* (Paul G.Wilson) K.A.Sheph. & Paul G.Wilson (formerly *Sclerostegia disarticulata* Paul G.Wilson) has florets within each 3-flowered cyme that are horizontal in orientation with the central bisexual floret being much larger than the two lateral male florets (Figure 1A, B), a perianth with two lateral lobes and a smaller abaxial lobe at the apex, and seeds with a length:width ratio of 1–1.9:1. In contrast, the other four species formerly included in *Sclerostegia* have vertical florets that are relatively equal in size, with only two perianth lobes at the apex, and seeds that are much longer than broad with a length:width ratio of 2–2.9:1 (Shepherd *et al.* 2005a).

Tecticornia disarticulata also has fruits that are unique within the subfamily Salicornioideae. Samphire fruits generally consist of a persistent perianth with a pericarp which may be free or fused

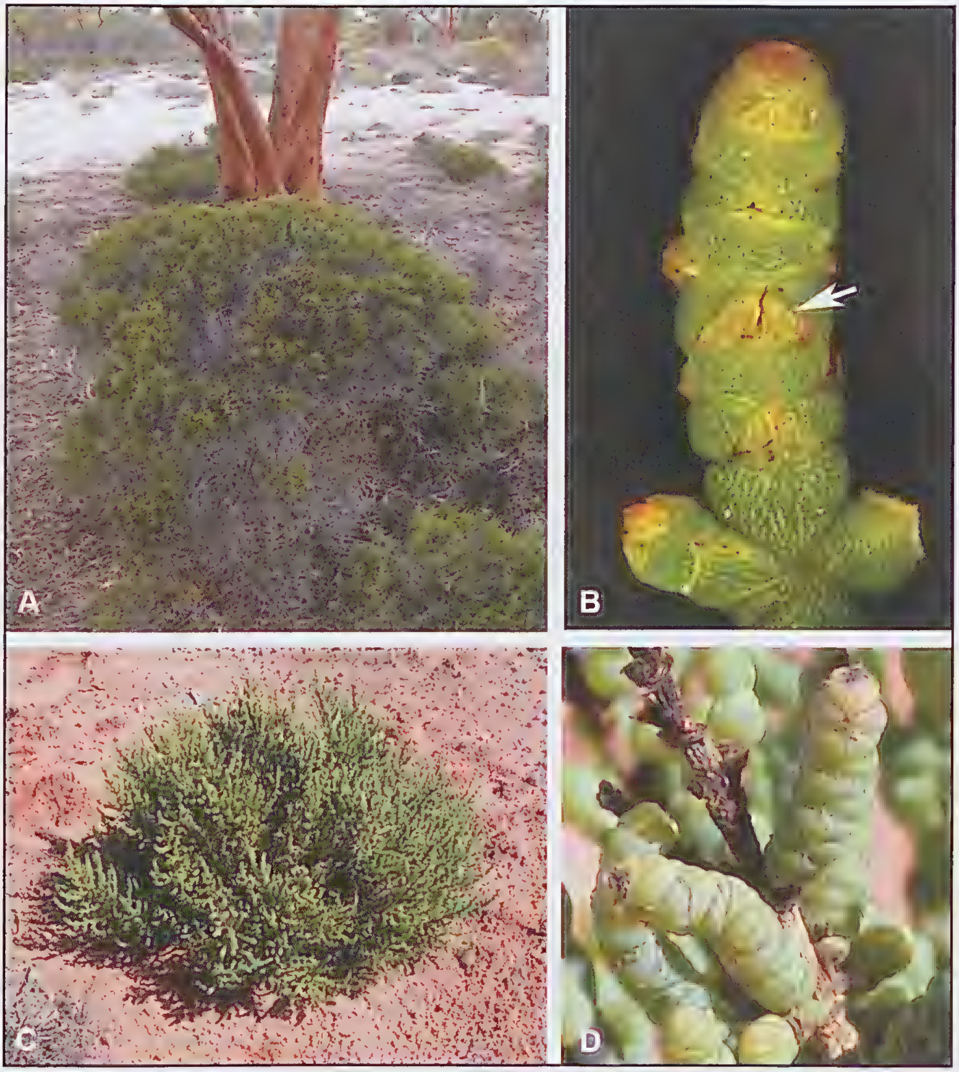

Figure 1. *Tecticornia disarticulata*. A – typical habit growing on high ground away from lake shorelines (*K.A. Shepherd & J.A. Wege* KS903); B – inflorescence with the large, bisexual central floret with stigma exserted (arrow) and small male lateral florets either side (*K.A. Shepherd & J.A. Wege* KS903); C – unusual form growing on the margin of a salt lake north of Bullfinch (*K.A. Shepherd & S.R. Willis* KS880); D – inflorescences that are slightly longer and wider than the typical form (*K.A. Shepherd & S.R. Willis* KS880).

to the inner surface of the perianth or the outer surface of the seed (Shepherd 2004). Only the central floret in the andromonoecious species produces a mature fruit containing a single seed. However, when the central floret matures in *T. disarticulata* it becomes apparent that there are two nodes of tissue similar in texture to the hardened pericarp fused to each side of the central fruit. These hardened nodes appear to be derived from the lateral florets and it is inferred that these flowers are male through the secondary loss of female organs. In contrast, the fruiting perianth/pericarp in the remaining four species formerly included in *Sclerostegia* remains membranous, with no trace of gynoecial material. The independent origin of andromonoecy in *T. disarticulata* is supported by molecular evidence, as this species did not resolve as sister to the other species formerly included in *Sclerostegia* (Shepherd *et al*. 2004, 2005b).

Tecticornia papillata K.A.Sheph., the new species described here, was first collected by Daphne Edinger in 1999, from the base of a quartzite hill near the Carnarvon Range north of the now abandoned Blue Hill station. Two years later she and Kevin Kenneally made another collection of this taxon and of *T. disarticulata* (PERTH 05850215) from the same region. On examination it is apparent that this species has the distinctive fruit previously only seen in *T. disarticulata*, but is readily distinguished by its conspicuously papillate epidermis, and the fimbriate margins and caudate apices of the vegetative articles and bracts.

Methods

Measurements were made from herbarium specimens lodged at the Western Australian Herbarium (PERTH) using calipers and a microscope graticule. Floral and fruit characters were measured using material rehydrated in a weak solution of hot water and detergent. Terminology used to describe the inflorescence structure follows Shepherd (2007). An electron micrograph of the seed was taken using an Environmental Scanning Electron Microscope following the methods of Danilastos (1993). The distribution map was created using DIVA-GIS Version 5.2.0.2 and show IBRA Version 6.1 regions (Department of the Environment, Water, Heritage and the Arts 2008). Precise localities were withheld due to conservation concerns.

Taxonomy

Tecticornia papillata K.A.Sheph., *sp. nov.*

Tecticorniae disarticulatae (Paul G.Wilson) K.A.Sheph. & Paul G.Wilson affinis a qua bracteis marginibus fimbriatis, apicibus caudatis et epidermide papillata, differt.

Typus: east-north-east of Blue Hill Station, south of boundary of Carnarvon Range, Western Australia [precise locality withheld for conservation reasons], 28 August 1999, *D.J. Edinger* Nats 61 (*holo*: PERTH 05428998; *iso*: CANB, MEL).

Sclerostegia sp. Blue Hill (D.J. Edinger Nats 61), in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 210 (2000).

Tecticornia sp. Blue Hill (D.J. Edinger Nats 61), Western Australian Herbarium, in *FloraBase*, http://florabase.dec.wa.gov.au [accessed 13 February 2008].

Perennial, erect sub-shrub to 0.4 m high. *Vegetative articles* obovoid in outline, circular to oval in cross section, dull yellow-green, 3–7 mm long, 1.8–4.5 mm wide, epidermis papillate, apex caudate, margin strongly fimbriate with fringe to 0.2 mm long. *Inflorescence* 3–13.5 mm long, 2–4.5 mm wide, of 3-flowered andromonoecious cymes, each triad comprising a bisexual central floret that is much larger than the male lateral florets, forming a spike of 3–9 nodes, with a sinuate or almost smooth, ovoid to ellipsoid outline, terminal to main or lateral branches. *Bracts* obovoid, free or fused, convex in face view with the upper edge curved, concave in side view with the upper edge curved, outer face of bract flat, epidermis papillate, apex caudate, 0.3–0.7 mm long, margin fimbriate with fringe 0.05–0.2 mm long, with overlapping subtending bracts. *Flowers* fully covered by subtending bracts or the apex of the central floret partially exposed, free from bracts above, fused to adjacent florets and sometimes fused to bracts below, free from opposite florets. *Perianth* fused, the adaxial surface horizontal and the abaxial surface ascending, sometimes becoming dorsiventrally flattened, apex truncate; lobes 3 with a small abaxial lobe inside two lateral lobes, margins slightly fimbriate. *Stamen* 1, the anther rounded to elliptic, 0.7–0.8 mm long, abaxial to the ovary. *Ovary* free from the stem cortex, style bifid, membranous. *Fruiting spike* expanded, pithy or crustaceous, disarticulating and falling from the branches at maturity. *Fruitlets* obscured by subtending bract or apex of the central fruit apparent, free from bracts above and below, remnant lateral fruits fused to large central fruit, free from opposite fruit; fruiting perianth membranous to areolate, upper edge papillate, not enclosing the pericarp, style at fruiting stage membranous or absent. *Pericarp* broadly obovoid with two nodes either side, crustaceous, enclosing the seed, eventually dehiscing in the medial plane. *Seed* free from the pericarp, vertical relative to the stem axis, ovate with a beak, 1.3–1.5 mm long, transparent, gold-brown without ornamentation. *Embryo* straight, perisperm present. (Figures 2, 3)

Specimens examined. WESTERN AUSTRALIA: [locality withheld for conservation reasons] 8 Aug. 2001, *K.F. Kenneally & D.J. Edinger* K 12254 E 2719 (PERTH 05850207).

Distribution and habitat. Occurs near the Carnarvon Range in the Gascoyne IBRA region of the Eremaean Botanical Province (Figure 4). This species is found growing on quartzite rubble on the flats below a quartzite hill.

Phenology. Flowering specimens seen in August. Fruits retained on plants for some months.

Conservation status. As this species is currently only known from a restricted population near the Carnarvon Range, Western Australia it was recently listed as Priority One under *Tecticornia* sp. Blue Hill (D.J. Edinger Nats 61), according to the Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora.

Etymology. From the Latin *papillatus* (bearing papillae) in reference to the dense papillae covering the epidermis.

Affinity. Tecticornia papillata is closely allied to *T. disarticulata* in being andromonoecious, having free and fused bracts within the inflorescence (which disarticulates at maturity), a central floret much larger than the lateral florets in each 3-flowered cyme, and two nodes of hardened gynoecial tissue fused to each side of the central fruit. It is readily distinguished from *T. disarticulata* in having a distinctly papillate epidermis and in both the vegetative articles and bracts being strongly fimbriate and having caudate apices.

Tecticornia papillata appears superficially similar to *T. fimbriata* (Paul G.Wilson) K.A.Sheph. & Paul G.Wilson, which also has caudate articles, bracts with fimbrate margins and a somewhat papillate epidermis. However, this species is bisexual and is readily distinguished from the andromonoecious *T. papillata* with its distinctive flowers and fruits. The seed of *T. fimbriata* is covered in small rounded bumps on the outer margin (Shepherd 2004; Shepherd *et al.* 2005a) while that of *T. papillata* is smooth (Figure 3B).

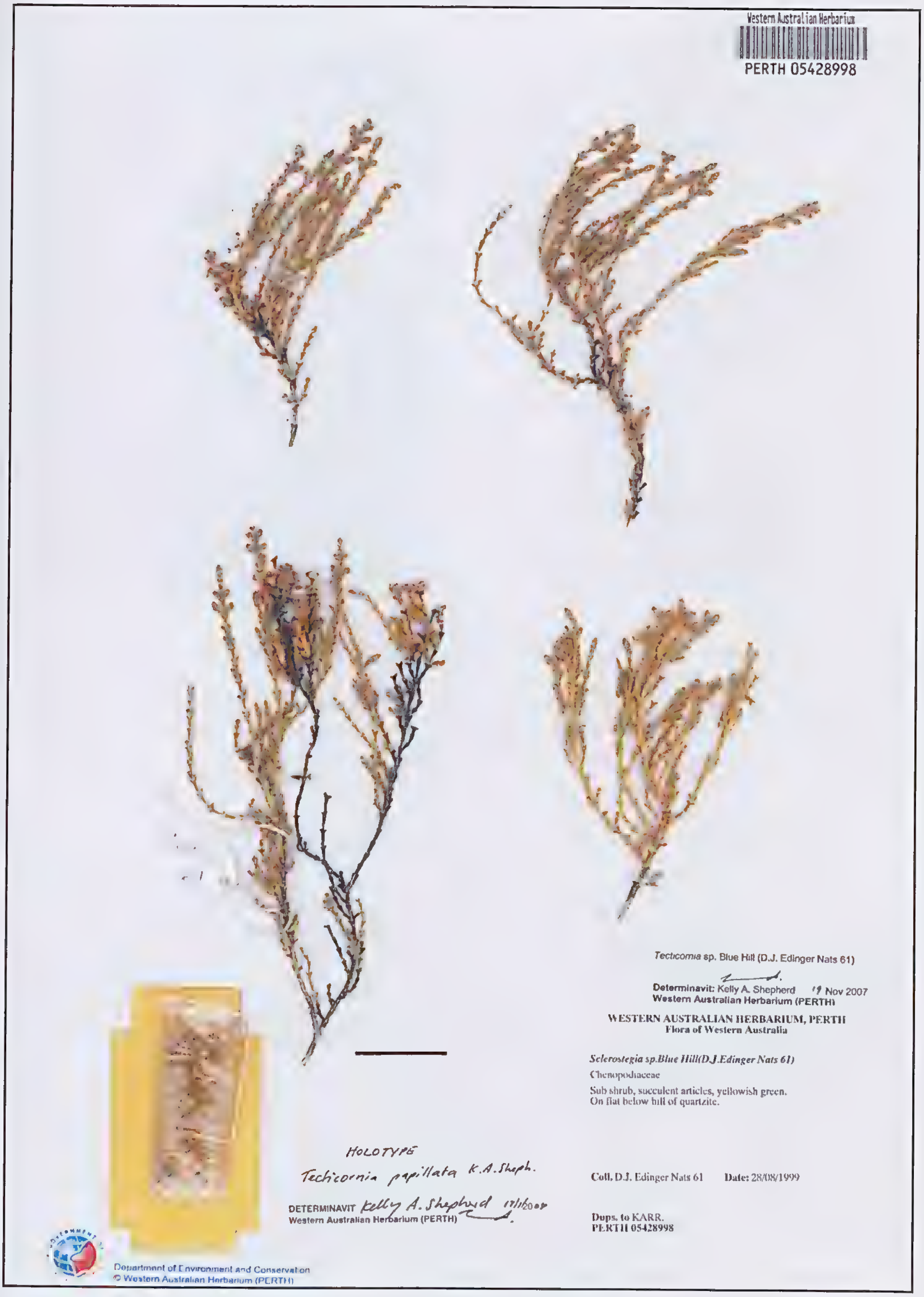
Western Australian Herbarium
PERTH 05428998
Tecticornia sp. Blue Hill (D.J. Edinger Nats 61)
Determinavit: Kelly A. Shepherd 19 Nov 2007
Western Australian Herbarium (PERTH)
WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia
Sclerostegia sp.Blue Hill(D.J.Edinger Nats 61)
Chenopodiaceae
Sub shrub, succulent articles, yellowish green.
On flat below hill of quartzite.
HOLOTYPE
Tecticornia papillata K.A.Sheph.
DETERMINAVIT Kelly A. Shepherd 17/1/2008
Western Australian Herbarium (PERTH)
Coll. D.J. Edinger Nats 61 Date: 28/08/1999
Dups. to KARR.
PERTH 05428998
Department of Environment and Conservation
© Western Australian Herbarium (PERTH)

Figure 2. Holotype of *Tecticornia papillata* (*D.J. Edinger* Nats 61), scale = 3cm.

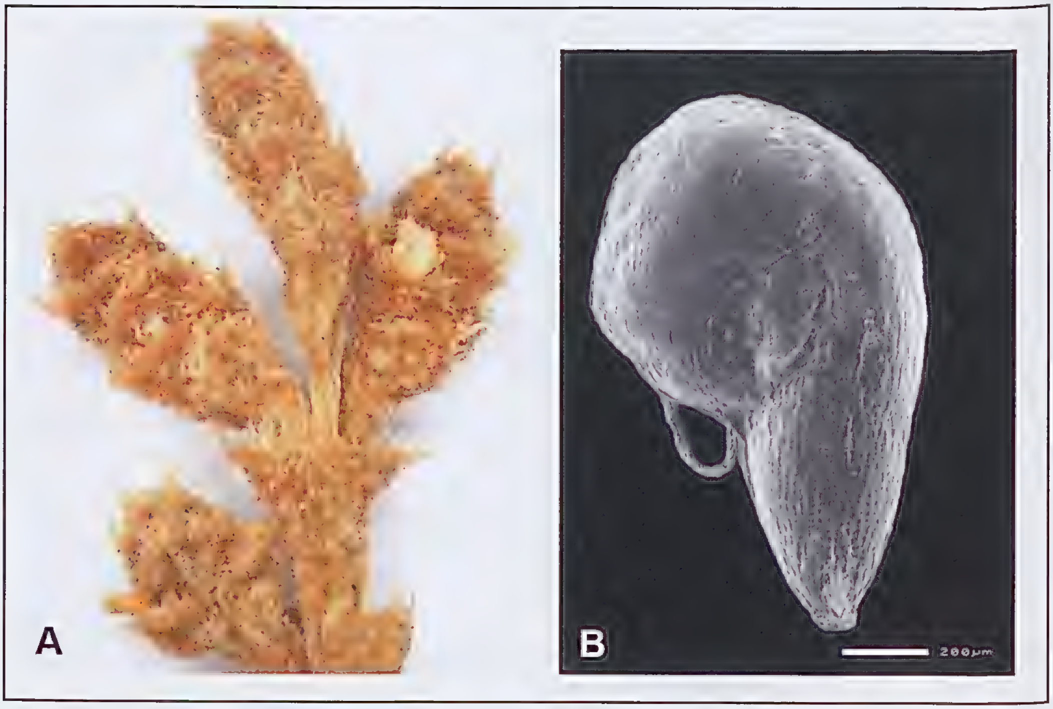

Figure 3. *Tecticornia papillata*. A – papillate epidermis of the inflorescences, showing the caudate apex and fimbrate margins of the bracts (*D.J. Edinger* Nats 61); B – ESEM image of a seed (*D.J. Edinger* Nats 61), scale bar = 200 µm.

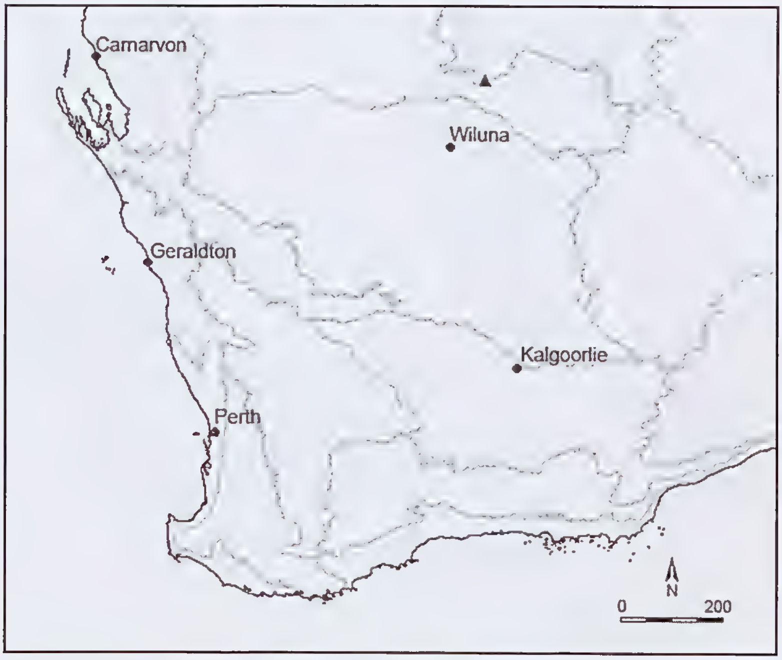

Figure 4. Distribution of *Tecticornia papillata* (▲) in Western Australia.

Notes on *Tecticornia disarticulata*

In the initial description of *Tecticornia disarticulata* (under *Sclerostegia*) Wilson (1980) noted two specimens, *D.G. Wilcox* 158 (PERTH 02676192) and *C.A. Gardner* 6141 (PERTH 02676184), had 'more deeply lobed articles which, with the bracts, are prominently denticulate on their margins.' Another six specimens at the Western Australian Herbarium (PERTH 02487322; PERTH 02487616; PERTH 05919274; PERTH 02487837; PERTH 02676257; PERTH 02487853) also have bracts with denticulate margins but these are much less divided than the fimbriate margins observed in *T. papillata*. Moreover, these specimens have a typically smooth epidermis.

Another specimen, *K.A. Shepherd & S.R. Willis* KS880 (PERTH 07692536) that was thought to be possibly distinct from *T. disarticulata*, on the basis of its longer and slightly wider inflorescences and that it occurs in a different habitat (growing on red sand near the northern end of Lake Baladjie rather than on stony hillsides or over limestone where this species is commonly found) (Figure 1C, D), was included in a molecular phylogenetic analysis as *Sclerostegia disarticulata* affin. KS880 (Shepherd *et al.* 2004). This specimen resolved as sister to *T. disarticulata* but had a number of unique base pairs. Further, recent collections of *T. disarticulata* from east of Parabado in the Karijini National Park (PERTH 07802366, 07802374), also appear to be somewhat morphologically distinct from the typical species in having longer, thinner inflorescences and glaucous articles. However, after examining the *c.* 110 specimens of *T. disarticulata* lodged at PERTH from across Australia, it is apparent that this species occurs in a relatively wide range of habitats and like most samphires, is morphologically variable. Neither the PERTH specimens with denticulate margins, the *K.A. Shepherd & S.R. Willis* KS880 specimen, nor the collections from east of Parabado can be clearly delineated from *T. disarticulata s.s.* It is clear that further molecular and morphological studies which sample widely across the range of *T. disarticulata* are required to resolve the status of potentially new taxa. It is anticipated that any taxa that may be distinguished from *T. disarticulata* would most likely be recognised at the infraspecific level, as the differences currently observed among the specimens are not as distinct as those that differentiate *T. papillata* from *T. disarticulata.*

Acknowledgements

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New combinations in the genus *Dysphania* (Chenopodiaceae)

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Abstract

Shepherd, K.A. & Wilson, P.G. New combinations in the genus *Dysphania* (Chenopodiaceae). *Nuytsia* 18: 267–272 (2008). A long standing recognition of a possible affinity between *Dysphania* R.Br. and *Chenopodium* L. subg. *Ambrosia* A.J.Scott has been corroborated by molecular phylogenetic evidence. While the North American species of *C.* subg. *Ambrosia* have been transferred to *Dysphania* this has not occurred elsewhere. In light of this, new combinations are made here for the Australian and New Zealand species of *C.* subg. *Ambrosia*. A key to the Australian species of *Dysphania* is provided.

Introduction

Dysphania R.Br. (1810) is recognised in the *Flora of Australia* (Wilson 1984b) as a small genus comprising ten species endemic to mainland Australia. These aromatic herbs are named from the Greek *dysphanes* (obscure, scarcely visible) apparently in reference to their minute flowers which occur in compact, cymose clusters. The members of *Dysphania* are also characterised by the presence of subsessile glands or simple and acuminate, multicellular, glandular hairs (Wilson 1983). The genus has at various times been included under sections within the genus *Chenopodium* L. (*C.* sect. *Dysphania* (R.Br.) Aellen and *C.* sect. *Tetrasepala* Aellen) (Aellen 1930; Black 1934), placed in the Illecebraceae (Hooker 1880), the Caryophyllaceae (Pax 1889) and even recognised as a distinct family, Dysphaniaceae (Pax 1927; Pax & Hoffman 1934; Aellen 1961; Eckhardt 1964; Airy Shaw 1966; Scott 1978).

In his revision of the Australian tribe Chenopodieae, Wilson (1983) noted that *Dysphania* showed an affinity with representatives of *Chenopodium* subg. *Ambrosia* A.J.Scott in having a similar habit and inflorescence type, and in the shared presence of glandular and simple septate hairs, as opposed to the mealy indumentum of bladder-like hairs typical of subg. *Chenopodium*. Two of the five sections recognised in subg. *Ambrosia* occur in Australia (sect. *Orthosporum* R.Br. and sect. *Ambrina* Hook.f.). Sect. *Orthosporum* (Table 1) is endemic to Australia and New Zealand and has flowers with 4–5 tepals and a single stamen, characters also present in *Dysphania*. It differs from *Dysphania* in having lenticular seeds with a hippocrepiform embryo curved around the apex, as opposed to the subglobular to globular seeds with a lateral or basal embryo typical of *Dysphania* (Wilson 1983). Sect. *Ambrina*, represented in Australia by introduced species, differs from *Dysphania* and all other Australian species of *Chenopodium* by their characteristic smell and by the distinctive geniculate hairs on the ovary (Wilson 1983) (Table 1). Later, Wilson (1987) proposed that the two introduced species in sect. *Ambrina* should in fact be transferred to a reinstated *Roubieva* Moq. However, Weber (1985) had come to a similar conclusion just a year earlier and had transferred sect. *Ambrina* to *Teloxys* Moq. instead.

Weber (1985) also implied that the Australian species of sect. *Orthosporum* should be included in the reinstated *Teloxys*. Wilson (1987) disagreed, again reiterating the apparent close relationship between the species of *Chenopodium* sect. *Orthosporum* and *Dysphania*. Wilson concluded that these species could either be transferred to *Dysphania,* included in a reinstated *Orthosporum* (R.Br.) T.F.L.Nees, or *Teloxys* and sect. *Orthosporum* could be included in an expanded *Dysphania*.

No nomenclatural recombinations were actually made until Mosyakin and Clemants (2002) addressed the status of *Chenopodium* in North America in preparation for their treatment for the *Flora of North America north of Mexico* (Clemants & Mosyakin 2003). The authors acknowledged the long-recognised affinity of subg. *Ambrosia* with the genus *Dysphania* and transferred the North American species (both endemic and introduced; Table 1) to *Dysphania*. Mosyakin and Clemants (2002) described a number of morphological characters that defined the newly expanded *Dysphania* including the types of glandular hair, leaf shape, venation and inflorescence, and a tendency towards more vertical seeds.

Table 1. Australian and New Zealand species of *Chenopodium* subg. *Ambrosia* now placed in *Dysphania* (*introduced in Australia).

Section	**Species**	**Distribution**	**Current name**
Orthosporum	*Chenopodium carinatum* R.Br.	Qld, NSW & Vic, cosmopolitan weed	*Dysphania carinata* (R.Br.) Mosyakin & Clemants
	Chenopodium cristatum (F.Muell.) F.Muell.	Widespread across Australia, south of 20° latitude; cosmopolitan weed	*Dysphania cristata* (F.Muell.) Mosyakin & Clemants
	Chenopodium melanocarpum (J.M.Black) J.M.Black	Widespread across Australia, south of 20° latitude	*Dysphania melanocarpa* (J.M.Black) Paul G.Wilson & K.A.Sheph.
	Chenopodium melanocarpum f. *leucocarpum* (Aellen) Paul G.Wilson	north-west WA, central SA, eastern QLD, NSW & Vic	*Dysphania melanocarpa* f. *leucocarpa* (Aellen) Paul G.Wilson & K.A.Sheph.
	Chenopodium pumilio R.Br.	southern Australia, occasional weed in northern Australia; cosmopolitan weed	*Dysphania pumilio* (R.Br.) Mosyakin & Clemants
	Chenopodium pusillum Hook.f.	North and South Island NZ	*Dysphania pusilla* (Hook.f.) Paul G.Wilson & K.A.Sheph.
	Chenopodium saxatile Paul G.Wilson	Widespread across arid zone WA	*Dysphania saxatilis* (Paul G.Wilson) Paul G.Wilson & K.A.Sheph.
	Chenopodium truncatum Paul G.Wilson	Qld, NSW, SA & NT	*Dysphania truncata* (Paul G.Wilson) Paul G.Wilson & K.A.Sheph.
Ambrina	* *Chenopodium ambrosioides* L.	Tropical America; cosmopolitan weed; disturbed sites coastal Australia	*Dysphania ambrosioides* (L.) Mosyakin & Clemants
	* *Chenopodium multifidum* L.	South America; cosmopolitan weed; disturbed sites coastal Australia	*Dysphania multifida* (L.) Mosyakin & Clemants

A molecular phylogenetic analysis of Amaranthaceae and Chenopodiaceae based on sequence variation in the cpDNA *rbc*L gene (Kadereit *et al.* 2003) included *Dysphania glomulifera* (Nees) Paul G.Wilson, two representatives of subg. *Ambrosia* (the Australian *Chenopodium cristatum* (F.Muell.) F.Muell. (sect. *Orthosporum*) and *C. botrys* L. (sect. *Botryoides*)), *Teloxys aristata* (L.) Moq., from central Asia, and a number of representatives from subg. *Chenopodium*. In this analysis the Australian species *C. cristatum* was placed sister to *Dysphania* with 73% maximum parsimony (MP) bootstrap support, forming a lineage sister to *C. botrys* with 95% MP bootstrap support. *Teloxys* was placed sister to the *Dysphania*+subg. *Ambrosia* clade (although without bootstrap support), forming a clade which the authors named Chenopodieae III (Figure 2, Kadereit *et al.* 2003). This clade provides evidence for the affinity of the glandular species of *Teloxys* (formerly *Chenopodium* subg. *Ambrosia* sect. *Ambrina*), *Chenopodium* subg. *Ambrosia* sect. *Orthosporum* and *Dysphania*. However, this study included very few representatives and there was no bootstrap support at the base of the Chenopodieae III clade (Kadereit *et al.* 2003).

Wilson (1987) considered that the North American species of *Chenopodium* sect. *Ambrina* may be generically distinct from *Chenopodium* sect. *Orthosporum* + *Dysphania*, but due to the limited availability of molecular sequence data this cannot be confirmed (or conversely, denied). We believe, however, that even with further analysis of sequence data from a broader sampling across all the sections now included in *Dysphania s.l.*, the close relationship between the species currently in *Chenopodium* sect. *Orthosporum* and *Dysphania s.s.* will not change. Therefore, new combinations made through transferring *Chenopodium* sect. *Orthosporum* to *Dysphania* are also unlikely to change in the future and so we make them here.

Mosyakin and Clemants (2002) also made the combination *Dysphania anthelmintica* (L.) Mosyakin & Clemants based on *Chenopodium anthelminticum* L. This taxon was considered by Wilson (1984a) to be a subspecies of *C. ambrosioides* L. and an assessment of the type material is required to determine its status.

Several nothotaxa are included in *Chenopodium* sect. *Orthosporum* (Wilson 1984a), but these names are not transferred to *Dysphania* sect. *Orthosporum* here because the extensive introgressive hybridisation between most of the species within this section inhibits their taxonomic resolution. We believe it more appropriate to refer to these nothotaxa by their hybrid formulae, e.g. *Chenopodium* ×*trigonocarpum* Aellen should be cited as *Dysphania cristata* × *D. melanocarpa*.

It should be noted that the orthography '*Orthospora*', used by Mosyakin and Clemants (2002) and by Clemants and Mosyakin (2003) in their sectional classification of *Dysphania*, is incorrect. The sectional epithet was first published by Brown (1810) as *Orthosporum*, which he had treated as a noun having the same form as a generic name; therefore its spelling does not alter regardless of the gender of the generic name.

New Combinations in *Dysphania* sect. *Orthosporum*

Dysphania melanocarpa (J.M.Black) Paul G.Wilson & K.A.Sheph., *comb. nov.*

Chenopodium carinatum var. *melanocarpum* J.M.Black, *Trans. & Proc. Roy. Soc. S. Australia* 46: 566 (1922); *Chenopodium melanocarpum* (J.M.Black) J.M.Black, *Trans. & Proc. Roy. Soc. S. Australia* 58: 173 (1934). *Type*: Broken Hill, N.S.W., Sep. 1918, per *T.G.B. Osborn* (*lecto*: AD, *fide* Wilson 1983).

Dysphania melanocarpa f. **leucocarpa** (Aellen) Paul G.Wilson & K.A.Sheph., *comb. nov.*

Chenopodium carinatum f. *leucocarpum* Aellen, *Verh. Naturf. Ges. Basel* 44: 313 (1933); *Chenopodium melanocarpum* f. *leucocarpum* (Aellen) Paul G.Wilson, *Nuytsia* 4: 176 (1983). *Type*: Minderoo, W.A., Oct. 1905, *A. Morrison* (*neo*: PERTH, *fide* Wilson 1983).

Dysphania melanocarpa (J.M.Black) Paul G.Wilson & K.A.Sheph. f. **melanocarpa**

Dysphania truncata (Paul G.Wilson) Paul G.Wilson & K.A.Sheph., *comb. nov.*

Chenopodium truncatum Paul G.Wilson, *Nuytsia* 4: 177 (1983). *Type*: 65 miles (105 km) W of Henbury Homestead, N.T., 10 Dec. 1968, *P.K. Latz* 255 (*holo*: AD; *iso*: CBG, NT).

Dysphania saxatilis (Paul G.Wilson) Paul G.Wilson & K.A.Sheph., *comb. nov.*

Chenopodium saxatile Paul G.Wilson, *Nuytsia* 4: 179 (1983). *Type*: 24 km east of Depot Springs Homestead, W.A., 27 Aug. 1970, *P.G. Wilson* 8909 (*holo*: PERTH; *iso*: K).

Dysphania pusilla (Hook.f.) Paul G.Wilson & K.A.Sheph., *comb. nov.*

Chenopodium pusillum Hook.f., *Handb. N. Zeal. Fl.* 1: 231 (1864). *Type*: Northern Island, New Zealand: shores of the east coast and sandy shores of Lake Taupo, abundant in native cultivated ground, *Colenso s.n.* (*holo*: K *n.v.*).

Amendments to the *Flora of Australia* Key

This key is a combination of the *Flora of Australia* keys to the species of *Dysphania* (Wilson 1984: 154) and the species of *Chenopodium* from couplet 1: (Wilson 1984: 135) with minor amendments.

1. Tepals 1–4

2. Tepals 1–3

3. Flowers in axillary clusters

4. Tepals of lateral flowers of clusters 1 or 2; seed erect, ellipsoidal to obovoid or laterally flattened

5. Tepals united at base; tepals shed with seed enclosed

6. Seed lenticular, the embryo curved around its base .... **D. valida**

6: Seed obovoid or ellipsoidal, the embryo lateral .... **D. glomulifera**

5: Tepals free; seed and tepals shed separately

7. Seed strongly flattened laterally (usually slightly twisted), ± obovate; pericarp almost smooth .... **D. platycarpa**

7: Seed ellipsoidal, obovoid or lenticular; pericarp smooth or glandular-papillate

8. Pericarp smooth, puncticulate or minutely papillate; seed ellipsoidal to obovoid or lenticular .... **D. glomulifera**

8: Pericarp prominently papillate; seed asymmetrically narrowly obovoid, the embryo side flat .... **D. glandulosa**

4: Tepals 3; seed turnip-shaped to subglobular .... **D. littoralis**

3: Flowers in spike-like inflorescences

9. Seed compressed-globular; embryo oblique to erect .... **D. sphaerosperma**

9: Seed ellipsoidal or broadly pear-shaped, erect; embryo lateral and basal

10. Tepals free, rounded or inconspicuously keeled on back .... **D. plantaginella**

10: Tepals united into a hard cup-shaped tube in lower half, prominently and horizontally keeled .... **D. simulans**

2: Tepals 4

11. Plant erect with one main stem; seed dull (rarely glossy), almost globular

12. Inflorescence spike-like, composed of compact axillary cymes .... **D. rhadinostachya**

12: Inflorescence paniculate, composed of open dichasia .... **D. saxatilis**

11: Plant prostrate or decumbent, many stems from the base; seed glossy, compressed globular .... **D. kalpari**

1: Tepals 5

13. Stamens 5; pericarp with geniculate glandular hairs

14. Leaves serrate; seed horizontal to oblique .... **D. ambrosioides**

14: Leaves pinnatisect; seed erect .... **D. multifida**

13: Stamens 1 or 2; pericarp glabrous, minutely puberulous or papillose

15. Tepals strongly crested

16. Perianth rostrate at apex; tepals free .... **D. cristata**

16: Perianth truncate at apex; tepals united .... **D. truncata**

15: Tepals rounded to acute on back or keeled

17. Tepals keeled at least towards apex .... **D. carinata**

17: Tepals rounded on back

18. Tepals firmly united in lower half, completely covering fruit, pale fawn or black .... **D. melanocarpa**

19. Fruiting perianth black .... **D. melanocarpa** f. **melanocarpa**

19: Fruiting perianth pale fawn .... **D. melanocarpa** f. **leucocarpa**

18: Tepals free to near base, not completely covering the fruit, white .... **D. pumilio**

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Pilostyles coccoidea (Apodanthaceae), a new species from Western Australia described from morphological and molecular evidence

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Abstract

Thiele, K.R., Wylie, S.J., Maccarone, L., Hollick, P. & McComb, J.A. *Pilostyles coccoidea* (Apodanthaceae), a new species from Western Australia described from morphological and molecular evidence. *Nuytsia* 18: 273–284 (2008). *Pilostyles coccoidea* K.R.Thiele, a new species of holoparasitic flowering plant found on the legume genus *Jacksonia* R.Br. ex Sm., is described and illustrated. The new species is related to *P. collina* Dell and *P. hamiltonii* C.A.Gardner, both also from south-western Western Australia but growing on different hosts. The three species differ in morphological features of flowers and fruits. In addition, analysis of *nad1*, 16S and *matR* gene sequences confirms the distinctness of *P. coccoidea* from *P. hamiltonii*. *Pilostyles coccoidea* appears to be a relatively common species within its restricted range of distribution between Eneabba and the Moore River, north of Perth.

Introduction

Pilostyles Guill. is a genus of *c.* 18 species of holoparasitic flowering plants found in tropical to temperate, arid to semi-arid regions of North and South America, the Middle East and south-western Australia. Previously included in the Rafflesiaceae, recent molecular studies (Barkman *et al.* 2004; Nickrent *et al.* 2004) have indicated that *Pilostyles* and related genera are not closely related to *Rafflesia*, resulting in the segregation of the small family Apodanthaceae Tiegh. ex Takht. for the genera *Pilostyles*, *Apodanthes* Poit. (seven species, tropical South America) and *Berlinianche* Harmsl de Vattimo (two species, tropical East Africa). *Berlinianche* is very similar to *Pilostyles* (Bouman & Meijer 1994) and should probably be included within it (Nickrent 2006).

All species of Apodanthaceae are achlorophyllous, comprising a filamentous mesh-like, endophyte which usually grows isophasically within stems of the host. Flowers are unisexual and develop from primordia formed endogenously within the host cortex just beneath the bark, emerging by rupturing through the stem surface. The flowers comprise one to several series of scale-like bracts and a series of bract-like tepals surrounding a large, central, column-like synandrium (in male flowers) or gynoecium (in female flowers) (Dell *et al.* 1982; Blarer *et al.* 2004).

Pilostyles and *Berlinianche* species parasitise several genera of legumes, while *Apodanthes* is found on a wider range of host families including Salicaceae, Burseraceae and Meliaceae (Blarer *et al.* 2004).

Pilostyles hamiltonii C.A.Gardner was described from Western Australia (Gardner 1948) from material collected on *Daviesia* Sm. at Mundaring. Subsequent collections recorded *Pilostyles* on *Jacksonia* R.Br. ex Sm. in the northern sandplains district between the Moore River and Eneabba, and on several *Gastrolobium*[1] R.Br. species from the Stirling Ranges (Kenneally & Pirkopf 1979) and on Peak Charles and Peak Eleanora in southern south-west Western Australia.

Dell and Burbidge (1981), in a survey of patterns of sexuality of *Pilostyles* flowers growing on different hosts, noted that mixed male and female *Pilostyles* flowers occurred on all stems on *Jacksonia* and *Gastrolobium* hosts, while on *Daviesia* most plants carried only male or female flowers. They concluded from this that the *Pilostyles* individuals on *Jacksonia* and *Gastrolobium* are monoecious, while on *Daviesia* they are dioecious. Occasional *Daviesia* individuals were found in which some stems bore male flowers while other stems bore female flowers, suggesting that the host individuals were probably infected by several *Pilostyles* individuals of differing sexes.

In addition to the difference in sexuality, Dell and Burbidge (1981) noted that *Pilostyles* flowers on different hosts differed in colour, being dark burgundy on *Daviesia*, pink and orange on *Gastrolobium* and orange on *Jacksonia*. They suggested that the three hosts may bear three distinct species of *Pilostyles*; Dell (1983) subsequently erected *P. collina* Dell for the southern, monoecious, pink-and-orange-flowered plants growing on *Gastrolobium*.

Field assessment and morphological and molecular analysis of the northern populations of *Pilostyles* on *Jacksonia* has confirmed that they too comprise a distinct species, which is morphologically and genetically distinct from *P. hamiltonii* on *Daviesia* and morphologically distinct from *P. collina* on *Gastrolobium*. Accordingly, the new species *Pilostyles coccoidea* K.R. Thiele is here described for these populations.

Materials and Methods

Fresh, dried and ethanol-preserved samples of *Pilostyles* flowers were used for morphological comparisons. Fresh or ethanol-preserved fruits and flowers of *Pilostyles* and fresh tip leaves of the hosts *Daviesia angulata* and *Jacksonia floribunda* and of *Lupinus angustifolius* cv. 'Wonga' were used for the DNA extractions (Appendix 1). The host legume samples were collected from plants within infected populations but that appeared to be uninfected with the parasite. These samples, and the *Lupinus* sample, were used to detect possible contamination of parasite DNA with host DNA.

Samples of *Pilostyles coccoidea* were collected from throughout its known range. *Pilostyles hamiltonii* samples were collected from both the northern (Cataby–Badgingarra) and central (Darling Range) parts of its distribution; populations in the southern part of the range near Bunbury were not sampled. Some sampled plants of *P. coccoidea* and *P. hamiltonii* in the Cataby area were less than 100 m apart.

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[1] *Oxylobium atropurpureum* Turcz. and *O. linearifolium* C.A.Gardner (= *O. linariifolium* (G.Don) Domin), recorded as hosts for *Pilostyles* in the southern part of its range by e.g. Dell & Burbidge (1981), are now included in *Gastrolobium*, as *G. leakeanum* J.Drumm. and *G. ebracteolatum* G.Chandler & Crisp respectively.

Pilostyles collina appears to be rare and occurs in localized populations in widely scattered locations. Recent extensive searches at known locations (Bluff Knoll, Peak Charles and Hyden) failed to locate plants. Attempts to extract DNA from herbarium samples held at PERTH failed, with the exception of a single specimen from the Hyden area (*A.S. George* 16442) which yielded intact DNA for analysis.

DNA extraction, PCR and sequence analysis. Samples for DNA analysis (100 mg) were frozen in liquid nitrogen, ground to a fine powder and extracted with a DNeasy Plant Miniprep kit (Qiagen). Amplification by polymerase chain reaction (PCR) of DNA sequences comprising the *nad1* (exons 2 and 3 of the mitochondrial NADH dehydrogenase gene), *matR* (mitochondrial maturase R), and 16S (small subunit of the plastid ribosomal RNA) gene regions were done with a 1:1 mixture of *Taq* and *Pfu* DNA polymerases (Promega) using the reaction buffer supplied with the *Pfu* polymerase. *Pfu* polymerase has 3'-5' exonuclease (proof-reading) activity and was used to reduce DNA polymerase-induced nucleotide misincorporations. PCR cycle conditions were as follows: 5 min at 94°C (denaturation) followed by 30 cycles of 94°C for 10 s, 55°C for 30 s, and 72°C for 1 min. Amplifications used the following primers: 16S *8for* (5'–GGAGAGTTCCTGGCTCAG–3') and *1461rev* (5'-GGTGATCCAGCCGCACCTTCCAG-3') (Nickrent *et al.* 1997); *matRfor* (5'-GTTTTCACACCATCGACCGACATCG-3') and *matRrev* (5'-GTTTTCACACCATCGACCGACATCG-3') (Nickrent & Starr 1994); and *nad1b* 5'-GCATTACGATCTGCAGCTCA-3') and *nad1c* (5'-GGAGCTCGATTAGTTTCTGC -3') (Demesure *et al.* 1995).

Both strands of PCR products were sequenced either (i) directly after purification by ethanol precipitation with the primers used in their amplification or (ii) after first cloning into the PCR® Blunt-Topo® (Invitrogen) vector, then using primers *M13F* (5'-TCCCAGTCACGACGTCGT-3') and *M13R* (5'-GGAAACAGCTATGACCATG-3'). Internal primers used to determine the full sequence of 16S were *660f* (5'-TATACTGACGTTGAGGGACG-3') and *990rev* (5'-CCTAACACTTCACTGCACGAACTG-3'), and for *matR* *matR703for* (5'-AAGTGTTAATAACAATTTAGC-3') and *matR781rev* (5'- CGGTGCTTTACCCGTAGACG -3').

Automated sequencing was performed with an Applied Biosystems Industries (ABI)/Hitachi 3730 DNA Analyzer using BigDye Terminator V3.1 chemistry (ABI).

Sequences were submitted to GenBank and assigned accession numbers (Appendix 1). Additional sequences were obtained from Genbank for *Pilostyles thurberi* (16S, *matR*), *Apodanthes caseariеae* (*matR*), *Glycine max* (*nad1*) and *Pisum sativum* (16S, *matR*) for comparative purposes (Appendix 1). Genetic diversity of sequences was deduced from nucleotide sequence alignments using ClustalW (Thompson *et al.* 1994) under default parameters and checked manually. Measures of genetic distance were computed using the Maximum Composite Likelihood model within MEGA4 (Tamura *et al.* 2007). Phylogenies were calculated using four different methods: Neighbor-joining (NJ), Minimum Evolution (ME), Unweighted Pair Group Method with Arithmetic mean (UPGMA), and Maximum Parsimony (MP). With all methods used, evaluation of statistical confidence for nucleotide and amino acid sequence groups was by the bootstrap test (1000 replicates).

Results

Morphologically, *Pilostyles coccoidea* differs from *P. hamiltonii*, in which it has been previously included, in host range, sexuality, flowering position, bract number, flower size and colour, and berry shape, and from *P. collina* in distribution, host range, flower colour and size, and in the number of bracts subtending the flowers (Table 1; Figure 1).

Table 1. Key differences between the three Western Australian species of *Pilostyles*

	P. hamiltonii	***P. coccoidea***	***P. collina***[1]
Distribution	Eneabba to Bunbury	Eneabba to Moore River	Stirling Ranges, Peak Charles, Hyden
Host	*Daviesia*	*Jacksonia*	*Gastrolobium*
Sexuality	Dioecious	Monoecious	Monoecious
Flowering position on host	Always on young (2-year old) stems	Usually on old wood, occasionally also on young stems	On young stems
Flower length	(3.5–)4.0–4.5 mm	(2.0–)2.8–3.9 mm	1.5–2.0 mm
Flower diameter	3.2–3.6 mm	1.8–2.5 mm	2.0–2.4 mm
Flower length/ diameter	1.1–1.3	0.75–1.1	0.8–1.0
Bracts	8–12, in 2 whorls	8–12, in 2 whorls	12–15, in 3 whorls
Bract colour	Dark burgundy	Pale orange-brown	Reddish-orange
Column colour	Pale cream	Dull pinkish-orange	Pink; ovary lemon yellow
Berry	Ovoid-turbinate to almost conical, enclosed and hidden by bracts and perianth to maturity, dull reddish	Depressed-globular, exposed within the erect to spreading bracts and perianth, bright orange-red to scarlet	Depressed-globular, exposed within the bracts (colour unknown)

[1] After Dell (1983)

All four sequence analysis methods (NJ, ME, MP and UPGMA) generated congruent phylograms from the nucleotide sequences. Consensus Neighbor-joining trees for each gene region are shown in Figure 2.

For the three gene regions analysed, there was clear evidence of genetic divergence between *P. coccoidea* and *P. hamiltonii.* No clear phylogeographic structuring was apparent within species, and closely sympatric populations of *P. coccoidea* and *P. hamiltonii* clustered separately. The average genetic distance was low within species (<0.003), and substantially higher between *P. coccoidea* and *P. hamiltonii* (*nad1*=0.070, 16S=0.177, *matR*=0.027 respectively; see Tables 2A–C). Only 16S was successfully sequenced from the DNA extracted from dried herbarium material of the Hyden population of *P. collina*. This sequence grouped closely with samples of *P. hamiltonii* (Figure 2B).

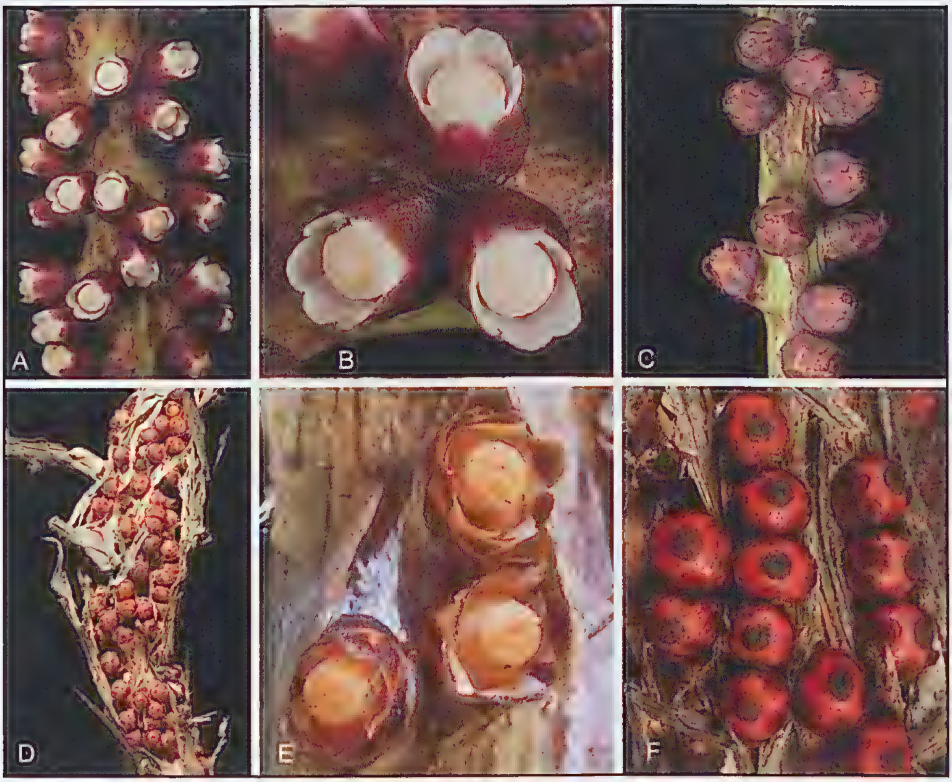


Figure 1. Flowers and fruits of *Pilostyles*. A – C. *P. hamiltonii*; A, B – flowers in situ on host stem (*K.R.Thiele* 3188); C – fruits (*K.R.Thiele* 3245). D – F. *P. coccoidea*; D, E – flowers in situ on host stem (*K.R.Thiele* 3495); F – fruits (*K.R.Thiele* 3242).

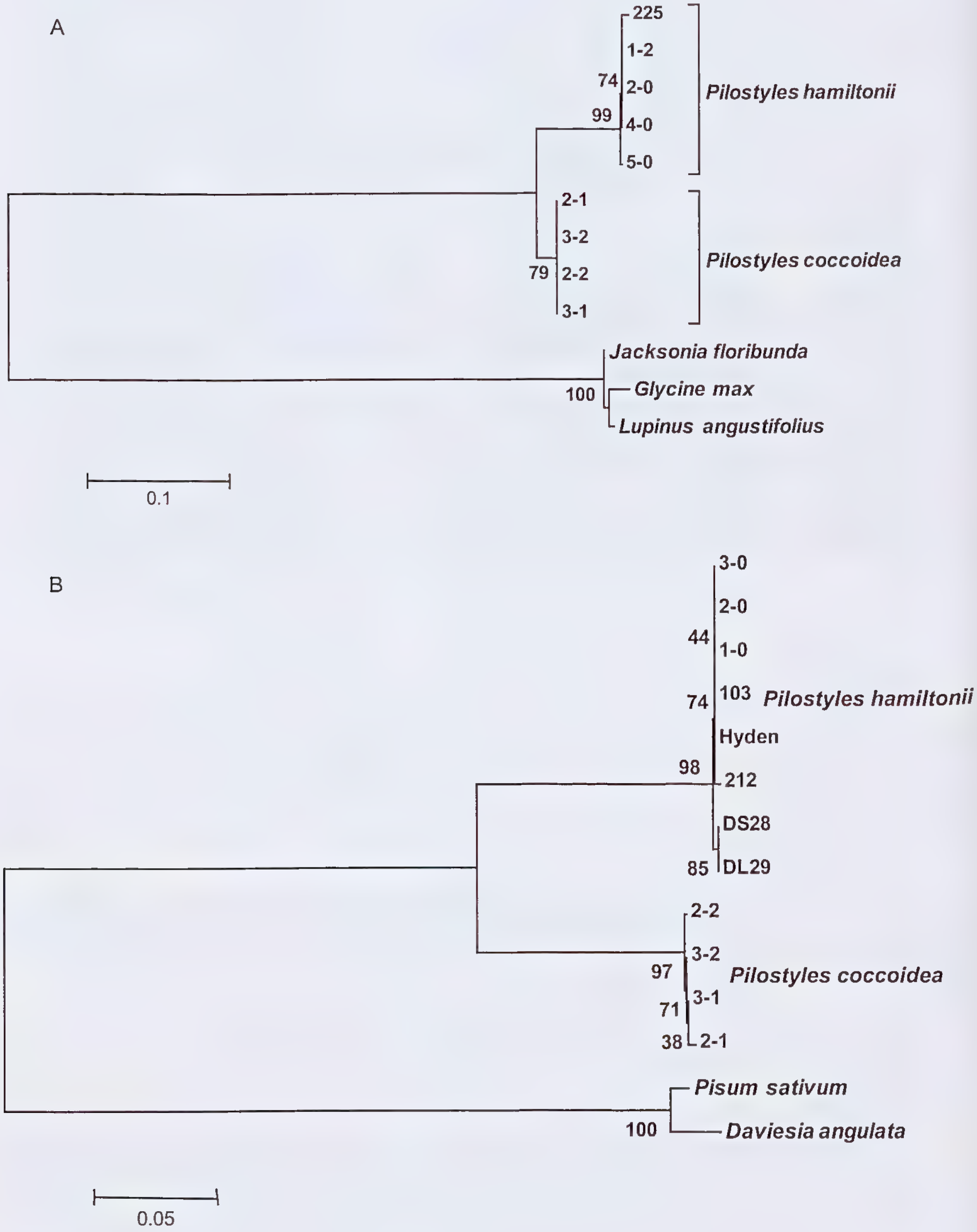
The *nad1* sequences of both *Pilostyles* species were very unusual, differing widely from one another and from those of other plants (Table 2A, Figure 2C). Between them, the two species had eight insertions and deletions (indels) in the *nad1* region sequenced, ranging from 1–72 nucleotides in length. Five indels were present in all five *P. hamiltonii* plants tested and a further three indels were present in all four *P. coccoidea* plants. Compared to other plant-derived nad1 sequences on GenBank, there was high sequence similarity only to short regions of the 5' and 3' termini; overall similarity is estimated to be less than 50%.

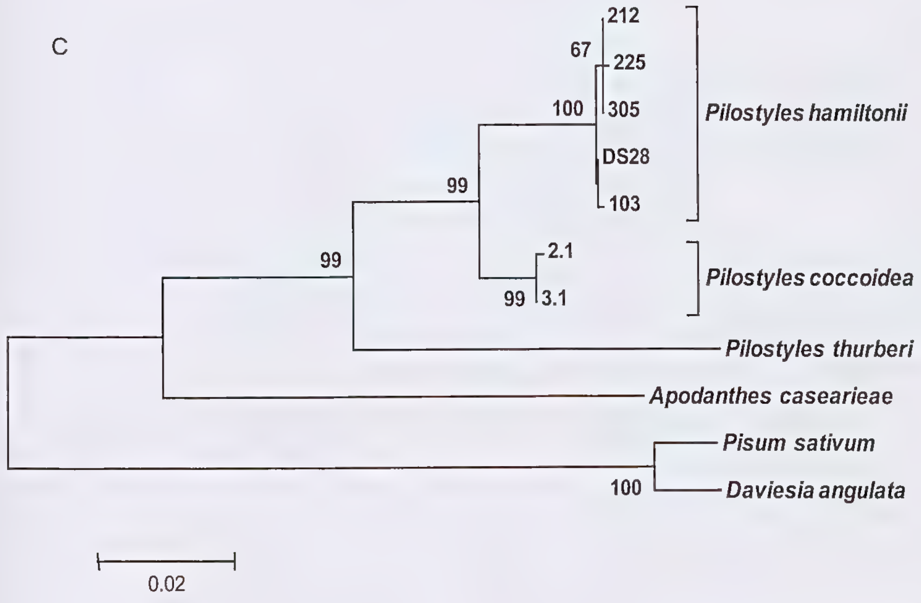
The 16S sequences were also very unusual (Table 2B, Figure 2B). The genetic distance between 16S sequences of the two Australian *Pilostyles* species was high (0.177), and they showed little similarity to those of legumes and, surprisingly, to that of *P. thurberi*.

The *matR* sequences of the Australian *Pilostyles* species were more similar to other plants (Table 2C, Figure 2C). As expected, they were closer to *P. thurberi* and *A. caseariae* than to host *matR* sequences.

Host and parasite sequences were clearly differentiated. Genetic distances in the *matR* sequences between the Australian *Pilostyles* and the legume host (where available) were substantial (0.185–0.190). *Pilostyles* 16S and *nad1* sequences showed much lower similarity with host homologues; the genetic distances shown (Figures 2B, 2C; Table 2B, 2C) are approximate because the sequences were so divergent that they were impossible to align with a high degree of confidence.

Figure 2. Neighbour-joining phylograms based on gene sequences for (A) *nad1*; (B) 16S and (C) *matR*; phylograms are drawn to scale, with branch lengths proportional to evolutionary distances. Numbers at the branches are bootstrap values (1000 replications) above 50 percent. The evolutionary distance scale is in the units of the number of nucleotide substitutions per site





Discussion

The low within-species and high between-species divergences of nucleotide sequences confirms the morphological distinctness of *P. coccoidea* and *P. hamiltonii* and supports their classification as distinct taxa.

The existence of eight indels in the *nad1* sequences of *Pilostyles* suggests that the *nad1* gene may be non-functional, and therefore not constrained by natural selection, but this was not proven experimentally. Similarly, the wide divergence of the 16S sequence indicates it may not be functional. On the other hand, the *matR* sequences were similar to homologues from other species and, therefore, may be functional. *MatR* and other mitochondrial genes have been used previously to classify parasitic angiosperms, including *Pilostyles* (Barkman *et al.* 2004; Barkman *et al.* 2007; Nickrent *et al.* 2004).

The relationship of *Pilostyles collina* to the other taxa is not clear. The single specimen that yielded DNA (*A.S. George* 16442) grouped within *P. hamiltonii* on the 16S analysis (Figure 2B). However, *P. collina* is morphologically more similar to *P. coccoidea* than it is to *P. hamiltonii* (Table 1), sharing relatively small flowers compared with *P. hamiltonii* and a berry that is exposed within the short bracts. Cross-contamination with a *P. hamiltonii* sample cannot be ruled out. Until new populations of *P. collina* can be located and fresh material collected, its relationships to the other two species will remain uncertain.

With the recognition of *Pilostyles coccoidea*, each of the three species of *Pilostyles* in Western Australia is considered to be restricted to a single host genus, but to occur on several species within its host genus. In general, host specificity in *Pilostyles* is relatively high, with the entire genus restricted to legume hosts (Nickrent 2006). Some species occur on several host genera (e.g. *P. thurberi* Gray on *Dalea formosa* Torr. and *Psorothamnus emoryi* (Gray) Rydb.). Factors controlling host range in Apodanthaceae are unknown.

Table 2. Mean nucleotide sequence diversity between and within species

A. nad1 sequences

Group	*P. coccoidea*	*P. hamiltonii*	*J. floribunda*	*G. max*	*L. angustifolius*
P. coccoidea	*0.000*[a]	0.070	0.551[b]	0.561[b]	0.555[b]
P. hamiltonii		*0.004*	0.573[b]	0.584[b]	0.578[b]
J. floribunda			-	0.016	0.002
G. max				-	0.018
L. angustifolius					-

B. 16S sequences

Group	*P. coccoidea*	*P. hamiltonii*	*P. thurberi*	*D. angulata*	*P. sativum*
P. coccoidea	*0.002*	0.177	0.601[b]	0.567[b]	0.539[b]
P. hamiltonii		*0.002*	0.608[b]	0.560[b]	0.554[b]
P. thurberi			-	0.701[b]	0.696[b]
D. angulata				-	0.027
P. sativum					-

C. matR sequences

Group	*P. coccoidea*	*P. hamiltonii*	*P. thurberi*	*A. casearieae*	*D. angulata*	*P. sativum*
P. coccoidea	*0.003*	0.027	0.080	0.125	0.185	0.184
P. hamiltonii		*0.001*	0.091	0.135	0.191	0.189
P. thurberi			-	0.152	0.208	0.208
A. casearieae				-	0.195	0.199
D. angulata					-	0.019
P. sativum						-

[a] Genetic distance (number of base substitutions per site as calculated by pairwise analysis).
[b] Figure given for genetic distance is an approximate value because sequences are highly divergent.
Inter-group mean sequence diversity is indicated in plain text. Intra-group mean sequence diversity is indicated in italics.

Early observers (e.g. Smith 1951) expected *Pilostyles hamiltonii* to be very widespread in south-western Western Australia, perhaps extending to the eastern States, on the basis of the wide distribution of the host genus and species. Dell & Burbidge (1981), however, with a more extensive knowledge of its distribution, noted the paradox that the parasite has a substantially more restricted distribution than its hosts. This is true both taxonomically and geographically: both *Daviesia* and *Jacksonia* contain many species not parasitised, and most individual species of host have a wider geographic distribution than the parasite. In particular, *P. hamiltonii* is widespread on *Daviesia* hosts on lateritic soils of the Darling Range but is absent from the same host species on sandy soils of the adjacent Swan Coastal Plain. Similarly, *P. coccoidea* is common on *Jacksonia floribunda* on the Eneabba Sandplains south to the Moore River, but the host species extends considerably further south to near Perth.

Taxonomy

Pilostyles coccoidea K.R.Thiele, *sp. nov.*

A *Pilostyles hamiltonii* floribus parvioribus, bracteis et columna pallida, aurantiaco-brunnea; baccis depresso ovoideis, rubro-aurantiacis, ad maturitatem expositis per bracteas effusas differt.

Typus: Waddi Road, 0.7 km from the Brand Highway, Western Australia, 30° 33' 26" S, 115° 28' 10" E, 7 March 2008, *K.R. Thiele* 3495 (*holo*: PERTH 07692447; *iso*: CANB, K, MEL, MO, NSW).

Pilostyles sp. Northern Sandplains (P. Armstrong *s.n.* PERTH 06590179), Western Australian Herbarium, in *FloraBase*, http://florabase.dec.wa.gov.au [accessed 10 March 2008].

Monoecious, endophytic perennial, the vegetative thallus ramifying within the host tissue. *Flowers* emergent singly from host stems, (2.0–)2.8–3.9 mm long, (1.8–)2.8–3.8 mm diam. (L/W 0.75–1.1) at anthesis, usually closely packed in groups and clusters, often aligned in fissures of bark, globose (although sometimes distorted from close packing). *Bracts* thick, fleshy, broad-based, imbricate, somewhat spreading at anthesis, 8–12 in two whorls of 4–6 each, 1.2–2.6 mm long, 1.0–2.2 mm wide, suborbicular to broadly ovate, the inner whorl longer and narrower than the outer, pale orange-brown darkening and withering at the tips at anthesis. *Perianth segments* 4–5(–8), similar to the bracts but with somewhat attenuate bases. *Disc and column* dull pinkish-orange, epigynous. *Male flowers* with central column (synandrium plus sterile gynoecium) shorter than the perianth, slightly inflated and dome-shaped at the apex, bearing a marginal ring of embedded anther-sacs below a ring of short papillae. *Female flowers* with an inferior to half-inferior, unilocular ovary and a short, thickened, column-like style expanded at the apex with a marginal, papillate stigmatic area and terminal depression; ovules many, on 4 parietal placentas. *Fruit* a depressed-globular, scarlet to orange-red berry surmounted by the prominent, darkened remnants of the stigma, 2.5–3.5(–4) mm diam.; bracts and perianth in fruit erect to spreading, exposing the berry; seeds *c.* 0.4 mm long, ± globular to broadly ellipsoid, corrugate. (Figure 1D–F)

Specimens examined. WESTERN AUSTRALIA: 16 km N of Badgingarra on Brand Highway, 18 May 1995, *P. Armstrong s.n.* (PERTH 06590179); 13.6 km N of Cataby on the Brand Highway, 9 June 1977, *A.H. Burbidge s.n.* (PERTH 01883151); entrance to Allied Eneabba, Brand Highway, Eneabba, 26 Aug. 1976, *B. Dell* 7687a (PERTH); 1 km S of Strathmore Road, on a track 1–2 km W of Brand Highway, 27 Aug. 1977, *B. Dell & A. Burbidge s.n.* (PERTH 03277658); Moore River National Park, 0.6 km at 180 degrees from junction of Red Gully Road and Brand Highway, NW of Gingin, 26 June 1988, *E.A. Griffin* 4775 (PERTH); Brand Highway 22.3 km N of southern roadhouse at Cataby, 20 Mar. 2007, *K.R. Thiele* 3197 (PERTH); Brand Highway 0.6 km N of the turnoff to Cooljarloo Mine, N of Cataby, 12 June 2007, *K.R. Thiele* 3242 (PERTH); Brand Highway at Badgingarra, *c.* 0.1 km N of the turnoff into the town, 12 June 2007, *K.R. Thiele* 3243 (PERTH); Brand Highway at southern turnoff to Iluka Resources Eneabba mine, S of Eneabba, 12 June 2007, *K.R. Thiele* 3246 (PERTH).

Distribution. Pilostyles coccoidea is endemic to the northern wheatbelt region of south-western Western Australia (Figure 3a). All known collections are from the immediate vicinity of the Brand Highway between the Moore River and Eneabba. It almost certainly occurs more widely in the region, but is probably poorly collected. Kenneally and Pirkopf (1979) cite an occurrence at Mt Lesueur, but there is no specimen at PERTH from this locality.

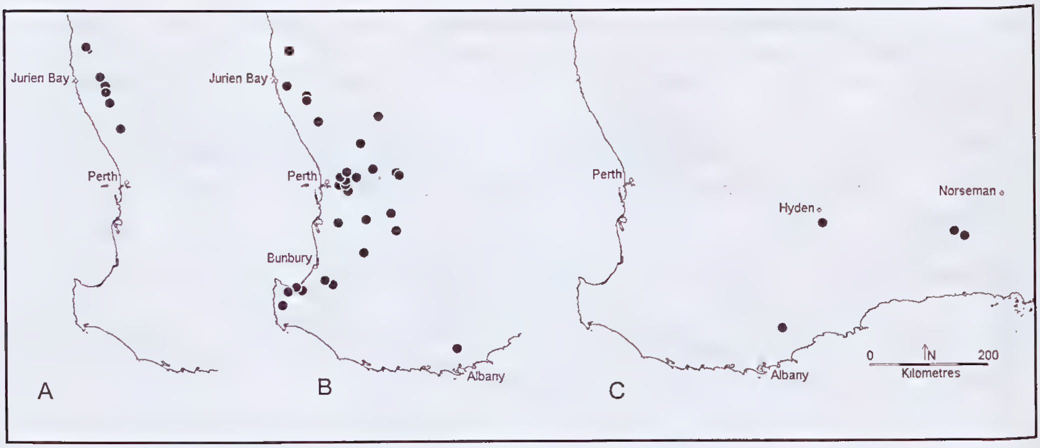


Figure 3. Distribution of *Pilostyles* species in south-west Western Australia. A – *P. coccoidea*; B – *P. hamiltonii*; C – *P. collina*. *Version 6.1 IBRA regions* (Department of the Environment, Water, Heritage and the Arts 2008) are indicated in grey.

Pilostyles coccoidea is sympatric with *P. hamiltonii* (Figure 3B), probably throughout its range, wherever the two hosts co-occur. It is widely allopatric from *P. collina* (Figure 3C).

Habitat. Pilostyles coccoidea has been found on two species of *Jacksonia*, *J. floribunda* Endl. and *J. nutans* Chappill, in low to tall, dense heath vegetation on sandy soil over laterite. Whereas *P. hamiltonii* and *P. collina* consistently flower on young (1–2-year old) stems of their hosts, *P. coccoidea* is usually found on much older wood, sometimes at the base of the plant where its flowers and fruits erupt from fissures in the bark of large, stout stems that are several years old. Flowers are sometimes virtually hidden beneath the papery outer bark layers on *J. floribunda*.

Flowering and fruiting period. Both *P. coccoidea* and *P. hamiltonii* on the northern sandplains flower together in February and March. Fruits persist on the hosts until July or August.

Conservation status. Pilostyles coccoidea appears to be relatively common within its range, and occurs in a number of National Parks and Nature Reserves in the region.

Etymology. The epithet is derived from the Latin *coccus* (a berry) with the termination *–oides* (like, similar), in reference to the remarkable superficial similarity of the fruiting plants to scale insects (Homoptera superfamily Coccoidea), particularly to species such as *Saissetia oleae* and *Eriococcus coriaceus*.

Notes. Pilostyles coccoidea differs most prominently from *P. hamiltonii* in its smaller flowers which are dull orange (dark burgundy in *P. hamiltonii*) and in the berry which is depressed-globular, scarlet and exposed by the spreading bracts (turbinate, dull-coloured and hidden by the erect bracts in *P. hamiltonii*). It differs from *P. collina* in its flower colour (reddish-orange, pink and lemon yellow in *P. collina*; *fide* Dell 1981), northern distribution, and fewer bracts.

Acknowledgements

We thank Arthur McComb and Rob Davis for help with fieldwork, Margaret Byrne and Bronwyn Collins for assistance with extractions of DNA material, Kelly Shepherd for a critical review of the manuscript and Juliet Wege for the maps.

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Appendix 1. Gene sequences used in this study.

Species	Sample code	Host species	Locality	Gene[a]	GenBank Accession	Reference
Pilostyles coccoidea	2-1	*J. floribunda*	Badgingarra	16S	EU512422	This study
				matR	EU512427	This study
				nad1		This study
	2-2	*J. floribunda*	Badgingarra	16S	EU512424	This study
				nad1		This study
	3-1	*J. floribunda*	Badgingarra	16S	EU512421	This study
				matR	EU512426	This study
				nad1		This study
	3-2	*J. floribunda*	Eneabba	16S	EU512423	This study
				nad1		This study
Pilostyles hamiltonii	DS28	*D. preissi*	Kalamunda	16S	EF446140	This study
				matR	EU512432	This study
	DL29	*D. decurrens*	Kalamunda	16S	EF446141	This study
	103	*D. angulata*	Kalamunda	*16S*	EF446143	This study
	136	*D. decurrens*	Kalamunda	*nad1*		This study
	212	*D. angulata*	Badgingarra	16S	EF446142	This study
				matR	EU512430	This study
	225	*D. angulata*	Badgingarra	*matR*	EU512424	This study
				nad1		This study
	305 (KRT 3242)	*D. angulata*	Cataby	*matR*	EU512431	This study
	1-0	*Daviesia sp.*	Badgingarra	16S	EU512419	This study
	1-2	*Daviesia sp.*	Eneabba	*nad1*		This study
	2-0	*Daviesia sp.*	Badgingarra	16S	EU512420	This study
				nad1		This study
	3-0	*Daviesia sp.*	Badgingarra	16S	EU512418	This study
	4-0	*Daviesia sp.*	Eneabba	*nad1*		This study
	5-0	*Daviesia sp.*	Eneabba	*nad1*		This study
Pilostyles collina	Hyden (ASG 16442)	*G. spinosum*	Hyden	16S	EU512425	This study
Pilostyles thurberi	2994	*Dalea formosa*	Texas, USA	*matR*	AY739003	Nickrent *et al.*, 2004
			Texas, USA	16S	U67741	Nickrent *et al.*, 1997
Apodanthes caseariae		*Casearia sp.*		*matR*	AY739002	Nickrent *et al.*, 2004
Daviesia angulata	214	-	Badgingarra	*matR*	EU512433	This study
				16S	EF446139	This study
Jacksonia floribunda	304	-	Cataby	*nad1*		This study
Lupinus angustifolius	*cv* Wonga	-	Perth	*nad1*		This study
Glycine max		-	Belgium	*nad1*	AJ428875	unpublished
Pisum sativum		-	N.Y., USA	16S	X51598	Cerutti & Jagendorf, 1991
			MI, USA	*matR*	AY453078	Barkman *et. al.*, 2004

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[a]. 16S = plastid 16S ribosomal RNA gene, partial cds; *matR* = mitochondrial maturase R gene, partial cds; *nad1* = mitochondrial NADH dehydrogenase subunit 1 gene, exons 2, and 3 and partial cds.

Stylidium perplexum (Stylidiaceae): a remarkable new triggerplant from south-west Western Australia

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Abstract

Wege, J.A. *Stylidium perplexum* (Stylidiaceae): a remarkable new triggerplant from south-west Western Australia. *Nuytsia* 18: 285–289 (2008). *Stylidium perplexum* Wege is newly described and photographs and a distribution map provided. This distinctive triggerplant has a tuberous, multi-stemmed and somewhat shrubby habit, discoid glandular trichomes restricted to the pedicels and hypanthia, linear leaves to 2 cm long, an elliptic hypanthium, narrow calyx lobes, and white to purplish laterally-paired corolla lobes bearing eight purple-tipped throat appendages. It occurs within a Conservation Park south-east of Dardanup and is listed as having conservation priority in Western Australia.

Introduction

Stylidium perplexum Wege (Stylidiaceae) was first collected by Graham S. McCutcheon in 1983 from near Dardanup in Western Australia. His specimen, erroneously identified as *S. fasciculatum* R.Br., remained embedded in the collection at the Western Australian Herbarium (PERTH) until recently discovered as part of ongoing taxonomic assessment of the State's triggerplant holdings. Although fragmentary—comprising an elongated, leafy stem portion and flowering scape rather than an entire plant—it could readily be referred to *S.* subgenus *Tolypangium* (Endl.) Mildbr. section *Saxifragoidea* Mildbr. on the basis of trichome and flower morphology; however, it could not be referred to any known species within this group and its precise growth form was unknown.

McCutcheon's collection site was successfully relocated in early November 2007, at which time *S. perplexum* was only just coming into flower. It was found to be a shrubby to sprawling perennial with a sizeable stem tuber. Remarkably, some individuals were observed to possess in excess of 200 leafy stems arising from the tuber. In view of its conspicuous habit and localised abundance, it is somewhat surprising that this triggerplant has, until recently, remained unknown to science.

Methods

The species description is based upon field observations and the examination of herbarium specimens, photographs and flowers preserved in 70% ethanol. The distribution map was compiled using DIVA-GIS freeware Version 5.2.0.2. Precise locality information has been withheld in view of this species rarity.

Taxonomy

Stylidium perplexum Wege, *sp. nov.*

Ab speciebus *Stylidii* aliis omnibus turma sequenti characterum distinguitur: caulis tuber magnum, irregulare; caules numerosi, foliiferi, ramificantes ad nodos; trichomata glandulosae, discoidea; folia lineares; hypanthium ellipticum.

Typus: south-east of Dardanup, Western Australia [precise locality withheld for conservation purposes], 29 November 2007, *J.A. Wege, K.R. Thiele & A.J. Stumpfel* JAW 1508 (*holo*: PERTH 07719922; *iso*: BRI, CANB, MEL).

Stylidium sp. Dardanup (G.S. McCutcheon GSM 1066), Western Australian Herbarium, in FloraBase, http://florabase.dec.wa.gov.au [accessed 10 January 2008].

Domed or sprawling shrublet 15–40 cm high. *Trichomes* glandular, 0.1–0.15 mm long, stalks translucent, heads black, discoid; eglandular trichomes absent. *Stems* elongate, arising from an irregular tuber, numerous (200+) in mature plants, branching at nodes to form a tangled network, occasionally rooting at nodes; internodes (1.5–)4–16 mm long, 0.6–1.2 mm wide, glabrous; new shoots straw-coloured, leafy, longitudinally-ridged; older internodes reddish-brown, smooth, becoming leafless; stilt roots absent. *Leaves* rosetted at stem apex, scattered beneath, linear, apex acute, margin entire, 0.5–2.5 cm long, 0.6–1.2 mm wide, glabrous. *Scapes* 8–19 cm high, 0.5–0.8 mm wide, glabrous. *Inflorescence* 6–14-flowered, paniculate or racemiform; units 1.5–2.2 cm long, 1–3-flowered; bracts subulate, 2–4.5 mm long, apex acute, margin entire, glabrous; bracteoles similar but smaller; pedicels to 8 mm long, glandular. *Hypanthium* ellipsoid, slightly compressed in T.S., 2.8–5 mm long, 1.2–2 mm wide, sparingly glandular. *Calyx lobes* free, apex acute, margin entire, inconspicuously gibbous at base, 2.5–4 mm long, 0.5–0.7 mm wide, glabrous. *Corolla* tube 1–1.2 mm long; lobes white, often blushed purple, laterally-paired, elliptic to narrowly ovate, 4–6 mm long, 2.2–3.6 mm wide, abaxial surface glabrous. *Labellum* reflexed and twisted across calyx lobes, boss ovate, terminal appendage 0.5–1 mm long, lateral appendages absent or rudimentary. *Throat appendages* 8, white with purple papillose tips, oblong, ± capitate, 0.3–1.2 mm long. *Column* 10–14 mm long, glabrous; anther locules parallel relative to column axis, black, subtending hairs absent; stigma very shortly stalked, entire. *Capsules* ellipsoid to obloid, 4–7 mm long excluding calyx lobes. *Seed* brown-black, ellipsoid, 0.6–0.8 mm long, 0.4–0.5 mm wide. (Figures 1, 2)

Other specimens examined. WESTERN AUSTRALIA: [localities withheld] 7 Dec. 1983, *G.S. McCutcheon* GSM 1066 (PERTH); 7 Nov. 2007, *J.A. Wege & R. Butcher* JAW 1470 (AD, NSW, PERTH); 7 Nov. 2007, *J.A. Wege & R. Butcher* JAW 1471 (CANB, MEL); 25 Jan. 2008, *J.A. Wege & B.P. Miller* JAW 1509 (CANB, MEL, PERTH).

Distribution and habitat. Stylidium perplexum is known from remnant bushland on the Whicher Scarp south-east of Dardanup in Western Australia (Figure 1E) where it grows in lateritic soils. It is apparently confined to, but common within, a narrow altitudinal gradient on an upper ridge slope bearing *Eucalyptus marginata* and *Corymbia haematoxylon* woodland over *Banksia grandis* and *Xanthorrhoea.*

Phenology. Flowers have been recorded in November and December, with peak flowering in late November to early December.

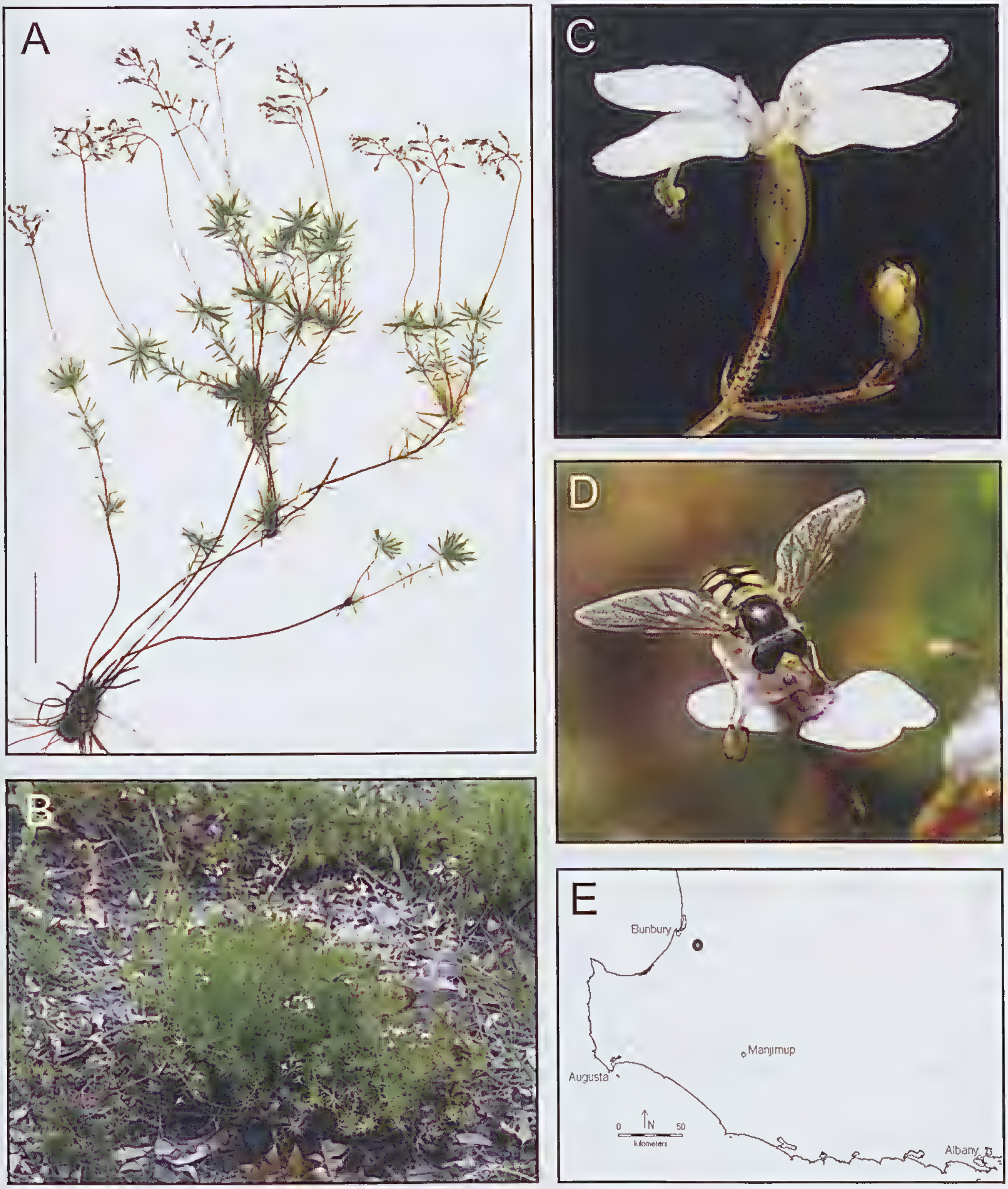

Figure 1. *Stylidium perplexum* (*J.A. Wege, K.R. Thiele & A.J. Stumpfel* JAW 1508). A – holotype, scale = 5 cm; B – habit; C – anterior view of flower showing the sparingly glandular hypanthium, lateral pairing of the corolla lobes and purple-tipped throat appendages. Note the labellum is obscured by the resting column and the stigma is developed; D – a triggered flower is visited by a syrphid fly; E – distribution in south-west Western Australia, with Version 6.1 IBRA regions (Department of the Environment, Water, Heritage and the Arts 2008) indicated in grey. Photographs by Juliet Wege (B, D) and Kevin Thiele (C).

Conservation status. *Stylidium perplexum* occurs within a Conservation Park of very high conservation value (Keighery *et al*. 2008), however, the known populations are adjacent to an active mineral sands mine and could be impacted by future mining activities. It is listed by Atkins (2008) as Priority One under Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora, under the name *Stylidium* sp. Dardanup (G.S. McCutcheon GSM 1066). Further survey is required to ascertain population size and extent within the Conservation Park and to determine whether this conservation listing should be upgraded to Declared Rare Flora.

Etymology. The specific epithet is derived from the Latin *perplexus* (tangled, intricate) and refers to the prolific production of wiry stems that become entangled with one another as the plant matures. It also eludes to my bewilderment when I first laid eyes on McCutcheon's collection of this species.

Spotting features. *Stylidium perplexum* can be distinguished from other species in the genus by the following combination of characters: an irregular stem tuber from which numerous, elongated and leafy stems arise; discoid glandular hairs; linear leaves; and an elliptic hypanthium.

Affinities. *Stylidium perplexum* is morphologically similar to *S. pritzelianum* Mildbr., a forest-dwelling species restricted to the Walpole and Denmark regions in southern Western Australia. Both species have wiry, intricately tangled stems, discoid glandular trichomes restricted to the pedicels and hypanthia, elliptic hypanthia, narrow and acute calyx lobes that are slightly gibbous at the base, and laterally-paired flowers bearing eight throat appendages. Although their flowers are quite similar, these two species differ markedly in leaf morphology and arrangement, with *S. pritzelianum* possessing oblanceolate leaves arranged in discrete whorls. It can be further differentiated from *S. perplexum* by its deep purple corolla lobes, smaller hypanthium (1.5–2.5 mm long × 0.7–1.3 mm wide), shorter calyx lobes (1.3–2.6 mm long), and shorter column (4.7–5.5 mm long).

Notes. Sterile material of *S. perplexum* may be confused with *S. fasciculatum* R.Br. and *S. adnatum* R.Br. (*S.* subgenus *Tolypangium* section *Rhynchangium* Benth.). These two species also possess a stem tuber, a shrubby, multi-stemmed habit and straw-coloured new shoots. Unlike *S. perplexum*, *S. fasciculatum* and *S. adnatum* possess glandular trichomes with ellipsoid heads, denser, more floriferous inflorescences, cylindrical hypanthia that are conspicuously narrowed at the apex, and flowers without throat appendages.

The type locality of *S. perplexum* has not been burnt for at least 13 years (G. Keighery pers. comm.) which accounts for the large size of individual plants. In the event of a fire, plants are likely to resprout from the stem tuber in addition to recruiting from seed. Unusually, only a relatively small proportion of the stems in any one individual bore flowering scapes in 2007. Whilst this may be a seasonal response to below average rainfall, it may also be characteristic of the species. Ovule number (*c*. 10–25 per flower) is relatively low for species in the genus suggesting that, in view of its tuberous habit, *S. perplexum* invests less energy into seed production. There was also evidence of clonality within the population: the laterally-spreading stems of some individuals were observed to produce fleshy roots from lower nodes situated in close proximity to the ground (Figure 2). Fragmentation of the subtending internodes would lead to the establishment of a clonal individuals.

Syrphid flies were seen actively visiting and pollinating *S. perplexum* (Figure 1D). Small native bees were also common visitors, however, they were never observed to trigger the release of the column.

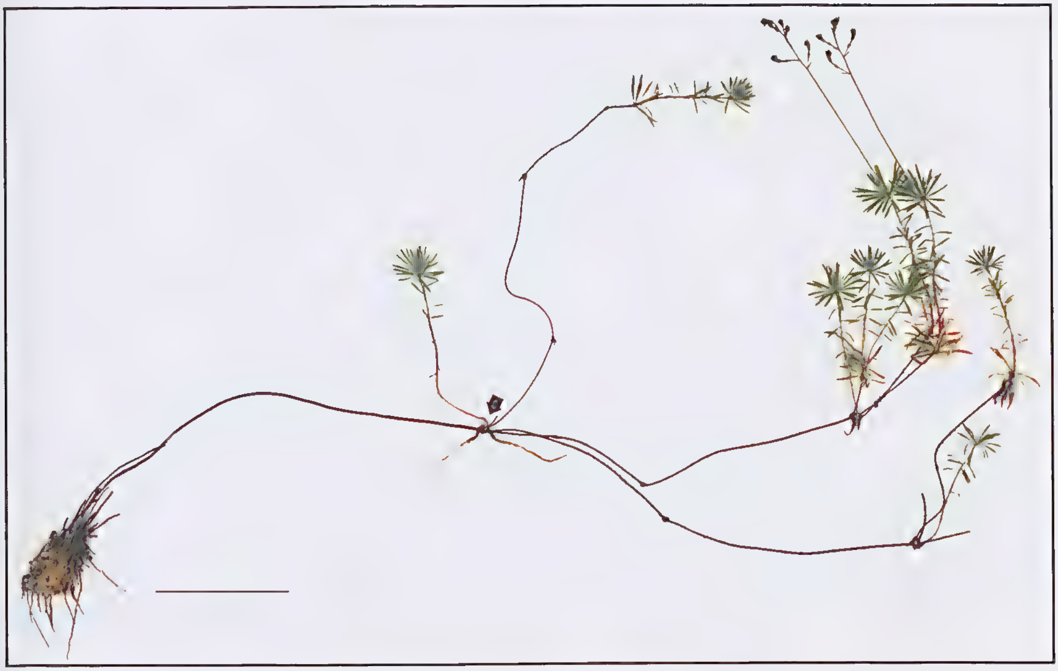

Figure 2. A laterally-spreading stem of *S. perplexum*, arising from the stem tuber. Fleshy roots have formed at the lower node (indicated with an arrow) which was in contact with the soil surface. A clonal plant would be created upon fragmentation of the stem below this node. From *J.A. Wege & R. Butcher JAW 1471*, scale = 5 cm.

Acknowledgements

This paper was funded by a grant to DEC Science Division from Ministerial funds for Swan Bioplan: a new conservation plan for the Swan Coastal Plain and adjacent escarpments. I thank Ryonen Butcher for her field assistance whilst relocating *Stylidium perplexum*, Kevin Thiele and Andrew Stumpfel for subsequent field help, Greg Keighery for providing maps and related information concerning McCutcheon's original collection site, and Bronwen Keighery for comments on the manuscript.

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A new subspecies of *Gnaphalium indutum* (Asteraceae: Gnaphalieae)

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Abstract

Wilson, P.G. A new subspecies of *Gnaphalium indutum* (Asteraceae: Gnaphalieae). *Nuytsia* 18: 291–293 (2008). *Gnaphalium indutum* Hook.f. is considered to consist of two infraspecific taxa, subsp. *indutum* and subsp. *acuminatum* Paul G.Wilson *subsp. nov.* The latter is predominantly an inland taxon of non-saline habitats.

Taxonomy

Gnaphalium indutum Hook.f., *London J. Bot.* 6:121(1847).

Type: Circular Head, Tasmania, 15 November 1836, *R.C. Gunn* 839 (*holo*: K *n.v.*, photo PERTH).

Rounded, cottony, multistemmed annual to 10 cm high. *Stems* weak, wiry. *Leaves* linear to linear-spathulate, obtuse, 5–10(–20) mm long. *Capitula* in upper axils, subsessile to slender-pedunculate forming globose corymbs, often subtended by leafy bracts that sometimes well exceed the capitula. *Involucres* cup-shaped, 2–3 mm high; outer bracts ovate, somewhat woolly, intermediate and inner bracts narrowly oblong to narrowly elliptic, acute or acuminate, sometimes minutely serrulate towards apex, sparsely woolly over the narrowly oblong stereome, straw-coloured or purple towards apex. Bisexual *florets* 4–6; corollas purple tipped. *Achenes c.* 0.7 mm long with minute, clavate, myxogenic duplex hairs.

Distribution. Found in southern Australia from the Abrolhos Islands, Western Australia, to far south-eastern New South Wales and Tasmania.

Two subspecies are recognised.

1. Inner involucral bracts obtuse to acute or evenly acuminate, the apices flat, entire, smooth .... subsp. **indutum**

1: Inner involucral bracts abruptly acuminate, the apices inwardly concave, denticulate, scabridulous .... subsp. **acuminatum**

Gnaphalium indutum Hook.f. subsp. **indutum**

G. sericeum Turcz., *Bull. Soc. Imp. Naturalistes Moscou* 24/2: 83(1851). *Type*: south-west Western Australia, *J. Drummond* 5th coll. n. 392 (*iso*: MEL 293593, MEL 283445, PERTH 00756547).

Inner *involucral bracts* obtuse to acute or evenly acuminate; apex smooth and flat, entire, pale yellowish or pale red, often reddish below apex as stripes on either side of stereome. *Florets* 20–30. *Pappus bristles* not, or only slightly, broadened at base where weakly united and soon free, caducous.

Distribution. Found in Tasmania and mainly coastal or near coastal southern Australia from the Abrolhos Islands, Western Australia, to far south-eastern New South Wales, also inland Victoria and inland south and south-eastern South Australia.

Habitat. Found around coastal and near coastal salt lakes, but also collected in areas that have not been noted as being saline.

Selected specimens examined. WESTERN AUSTRALIA: Walpole-Nornalup National Park, 25 Sep. 1992, *J.R. Wheeler* 3324 (PERTH). SOUTH AUSTRALIA: False Cape, Kangaroo Is., *B.M. Overton* 892 (AD). NEW SOUTH WALES: Mowarry Point, 3 Oct. 1975, *A. Slee* (CANB). VICTORIA: Port Fairy, Oct. 1889, *H.B. Williamson* (CANB). TASMANIA: Cape Portland, *A. Moscal* 3178 (HO).

Notes. As delimited here this subspecies is somewhat variable morphologically. The pappus bristles are sometimes not at all broadened at base and are then virtually free, while sometimes they are slightly broadened and weakly connate. This morphological variability, along with the diverse habitats, suggests that there may be more than one taxon included under this name.

Gnaphalium indutum subsp. **acuminatum** Paul G.Wilson, *subsp. nov.*

Ab subsp. *induto* bracteis involucri abrupte acuminatis, ad apicem minute scabridulis, denticulatis, rubescentibus vel lutescentibus, setis pappi ad basim latioribus differt.

Typus: Dookie College of Agriculture, Victoria, 2 November 1992, *J.E. Strudwick* 909 (*holo*: MEL; *iso*: CANB).

Inner *involucral bracts* abruptly acuminate; apical portion minutely scabridulous, denticulate, inwardly concave, reddish or becoming yellowish at tip, the colouration not extending downwards to the stereome. *Florets* c. 50. *Pappus bristles* noticeably broadened and shortly united at base, persistent or semi-persistent.

Distribution. Found in inland areas of Victoria (rarely near-coastal) and in the extreme south-central area of New South Wales.

Habitat. Occurs in woodland and scrub in non-saline soils.

Selected specimens examined. NEW SOUTH WALES: The Rocks, between Berrigan and Tocumwal, Oct. 1979, *W.E. Mulham* (NSW). VICTORIA: Puckapunyal, 1.7 km NNE of Mt Disappointment, *R.J. Adair* 2090 (MEL); 6.5 km SE of Seaton, *D.E. Albrecht* 1923 (MEL); Mt Arapiles, *A.C. Beauglehole* 16641 (MEL); Brisbane Range National Park, *A.C. Beauglehole* 56659 (MEL); Glenmaggie Regional Park, *A.C. Beauglehole* 78623 (MEL); Warby Ranges State Park, *A.C. Beauglehole* 80793 (MEL); Cosstick Reserve, 2 miles (*c*. 3 km) west of Maryborough, *T.B. Muir* 1466 (MEL); Euroa, *R. Thomas* 343 (MEL); St Leonards, Bellarine Peninsula, 9 Nov. 1947, *J.H. Willis* (MEL); Batesford, 11 Oct. 1981, *J.H. Willis* (MEL).

Notes. The only coastal or near-coastal collection of this subspecies was that made by J.H. Willis at St Leonards (see above), where it was found growing on 'wet flats under Red Gum'. Willis noted that it was a form 'with acuminate and apically laciniate bracts and more papillose achenes than in the usual, typical form'.

Acknowledgements

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Coronidium, a new Australian genus in the Gnaphalieae (Asteraceae)

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Abstract

Wilson, P. G. *Coronidium,* a new Australian genus in the Gnaphalieae (Asteraceae). *Nuytsia* 18: 295–329 (2008). The genus *Coronidium* Paul G.Wilson, a segregate of *Helichrysum* Mill. *sensu lato*, is described. It consists of 17 species, all of which are found in eastern Australia while two are also present in South Australia and one in Tasmania. Six species and two subspecies are described as new: *C. cymosum* Paul G.Wilson, *C. elatum* (A.Cunn. ex DC.) Paul G.Wilson subsp. *minus* Paul G.Wilson, *C. elatum* subsp. *vellerosum* Paul G.Wilson, *C. flavum* Paul G.Wilson, *C. fulvidum* Paul G.Wilson, *C. lanosum* Paul G.Wilson, *C. kaputaricum* Paul G.Wilson, and *C. telfordii* Paul G.Wilson, while *Helichrysum adenophorum* var. *waddelliae* J.H.Willis is raised to species rank as *C. waddelliae* (J.H.Willis) Paul G.Wilson; a further ten species are transfers from *Helichrysum*: *C. oxylepis* (F.Muell.) Paul G.Wilson, *C. rupicola* (DC.) Paul G.Wilson, *C. glutinosum* (Hook.) Paul G.Wilson, *C. lanuginosum* (A.Cunn. ex DC.) Paul G.Wilson, *C. newcastlianum* (Domin) Paul G.Wilson, *C. boormanii* (Maiden & Betche) Paul G.Wilson, *C. elatum* (DC.) Paul G.Wilson, *C. lindsayanum* (Domin) Paul G.Wilson, *C. adenophorum* (F.Muell.) Paul G Wilson, and *C. scorpioides* (Labill.) Paul G.Wilson. Several names are lectotypified.

Introduction

The species discussed in this paper are endemic to eastern Australia with the exception of *Coronidium adenophorum* (F.Muell.) Paul G.Wilson whose distribution extends into south-eastern South Australia and *C. scorpioides* (Labill.) Paul G.Wilson which is also found in South Australia and Tasmania. All, except for those newly described, were previously included in *Helichrysum* Mill.

The genus *Helichrysum s.lat.* has long been recognised as polyphyletic and an outline of the taxonomic confusion within that genus was presented by Hilliard and Burtt (1981) and by Anderberg (1991). They indicated that *Helichrysum* is to be treated as a genus of Africa and Eurasia, although even in this restricted sense it appears to be polyphyletic. In Australia the genus as delimited by Bentham (1867) has been dismembered with the following genera recognised by Anderberg (1991) or accepted subsequent to his review: *Cassinia* R.Br. (1817), *Ozothamnus* R.Br. (1817), *Lawrencella* Lindl. (1839), *Chrysocephalum* Walp. (1841), *Gratwickia* F.Muell. (1895), *Xerochrysum* Tzvelev (1990) (syn. *Bracteantha* Anderb. & L.Haegi in Anderberg 1991), *Anemocarpa* Paul G.Wilson (1992), *Argentipallium* Paul G.Wilson (1992), and *Cremnothamnus* Puttock (1994). The genus *Helichrysum* has recently been re-instated for Australia with the recognition of *Gnaphalium luteoalbum* L. as *Helichrysum luteoalbum* (L.) Rchb. (Galbany-Casals *et al.* 2004).

Of the species discussed here, Candolle (1838) placed *Helichrysum rupicola* DC. (with *H. collinum* DC.) in sect. *Helichrysum* Mill. [sub-series] *Oxylepidea*, *H. elatum* DC. with *H. leucopsideum* DC. in sect. *Blepharolepis* DC. [informal group] *Argyrolepis* along with a number of other Australian species now referred to other genera, and *H. scorpioides* Labill. in sect. *Blepharolepis* [informal group] *Chrysolepis*.

Bentham (1867) raised *Helichrysum* ser. *Chrysolepidea* DC. subser. *Xerochlaena* DC. to sectional rank under *Helichrysum* and included in it *H. bracteatum* (Vent.) Willd., *H. scorpioides*, *H. rutidolepis* DC., those species referred below to the '*Xerochrysum leucopsideum*' group, and a number of other species now placed in other genera. He placed *H. oxylepis* F.Muell., *H. collinum*, and *H. rupicola* in *Helichrysum* sect. *Oxylepis* Benth. which therefore corresponded to Candolle's *Helichrysum* [sub-series] *Oxylepidea*.

Anderberg, *op. cit.* listed 22 Australian (and two New Zealand) species in a *Lawrencella* '*Scorpioides*' complex. Nine of these species are here included in a new genus *Coronidium*; they represent some that were listed by Bentham (1867) in *Helichrysum* sections *Xerochlaena* and *Oxylepis* and referred by Wilson (1992) to the '*Helichrysum elatum* group'.

Bayer *et al.* (2002) published a paper on the phylogeny of the Australian Gnaphalieae based on molecular data. This analysis did not include any of the species here placed in *Coronidium*.

Morphological data

Those morphological features that are most readily categorised, and which are used to distinguish the segregates of *Helichrysum*, are found in the involucral bracts, the cypsela and the pappus.

Involucral bracts

The median involucral bracts consist of a largely cartilaginous basal claw and a terminal, flat, papery lamina. The claw may be flat, semi-terete or terete; it has one to several vascular strands that are found in a thickened, semi-opaque cartilaginous area, the stereome. The stereome may appear divided towards its apex so as to form a clear zone (a fenestra or window) within a semi-opaque surround and is then referred to as being fenestrated (Drury 1970).

The vascular strands of the stereome may terminate at the apex of the claw (as in *Xerochrysum bracteatum* (Vent.) Tzvelev), or the central or solitary strand may continue into the lamina (as occurs in species here included in *Coronidium*). In some species the presence or absence of a fenestra depends on the position of the bract in the involucre, thus in *X. bracteatum* the claws of the inner involucral bracts are fenestrate while those of the median are not.

Cypsela

The cypsela anatomy of a number of species of *Helichrysum s.lat.* was investigated by Tvrtković-Šahin (1982). She remarked on the presence of paired idioblasts with anticlinal walls in the epicarp of the cypsela in *Helichrysum bracteatum* (=*Xerochrysum bracteatum*) and in a group of apparently related Australian species of *Helichrysum* that were subsequently referred to the '*Helichrysum elatum* group' by Wilson (1992). The shape of these idioblasts ('fenestrae' of Wilson 1992) is largely species specific and the associated epicarp cells show considerable variation in the cuticular sculpturing of the periclinal walls and in the presence or absence of scattered micropapillae (only recorded on the epicarp of *H. elatum*). The species of the *H. elatum* group are here placed in *Coronidium* (Figure 1). The laterally paired idioblasts contrast with the vertically paired (usually myxogenic) papillae that are found in a number of genera of the Gnaphalieae, e.g. *Actinobole* Endl., *Anemocarpa, Hyalosperma* Steetz, and *Millotia* Cass.

Pappus

In all Australian genera of the '*Helichrysum*' group the pappus is made up of denticulate or shortly plumose capillary bristles without spreading basal cilia. These bristles are broader at their base; they may remain free or may be united to form a basal ring. The pappus, if of basally united bristles, may persist in its entirety, may shed the free portions of its bristles, or may be deciduous as a whole.

The bristles of the species in the *Coronidium oxylepis* group are fused to each other for about the basal 0.03 mm and readily break about 0.15 mm above the base (Figure 1A). At the zone of dehiscence the cells of the bristle are quadrate and are only loosely attached to neighbouring cells, while above and below this zone the cells of the bristle are narrowly oblong to linear and are firmly fused together.

In the *C. elatum* group (Figure 1B) the bristles are free to their base and are either deciduous as a whole or are semi-persistent and then sometimes break unevenly near the base to produce a frayed margin, the cells at the area of the fracture being linear-acuminate and splinter-like.

The infrageneric groups compared

The most obvious morphological differences between *Coronidium* (groups '*oxylepis*', '*elatum'*, and '*scorpioides*'), the '*Xerochrysum bracteatum*' group, and the '*Xerochrysum leucopsideum*' group are outlined below.

Xerochrysum bracteatum group

Median involucral bracts: claw broadly oblong; stereome broad with several anastomosing veins that terminate at apex of claw.

Cypsela: pericarp thick, collenchymatous to sclerenchymatous, smooth; apex patelliform, the pericarp extending slightly around base of pappus, bristles united at base and the pappus deciduous as a whole or persistent and intact.

Idioblasts: linear, laterally paired.

Plants: not rhizomatous.

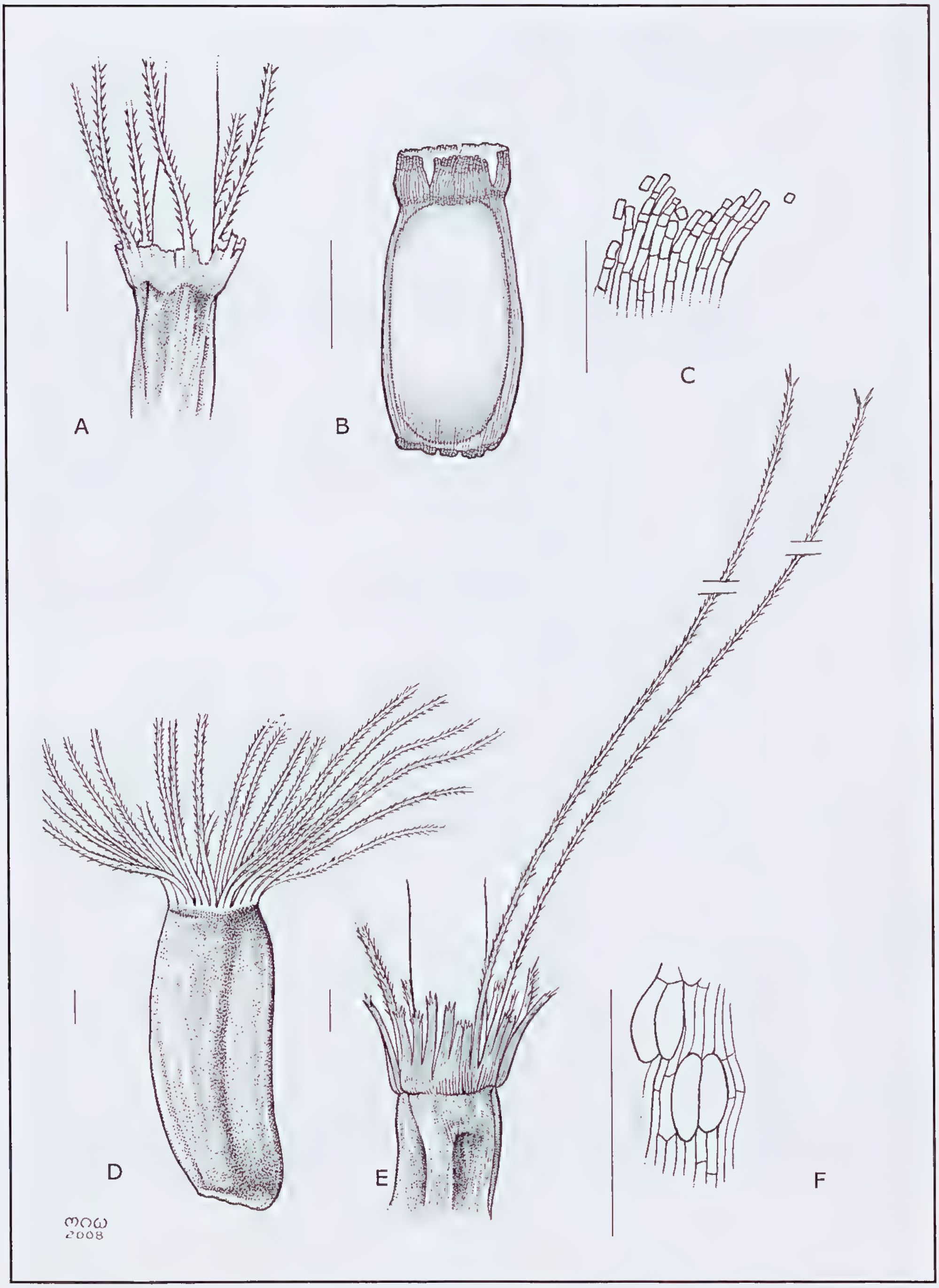


Figure 1. A. *Coronidium oxylepis* – immature cypsela showing partial dehiscence of pappus; B. *Coronidium rupicola* – cypsela with dehisced pappus (note translucent pericarp); C. *Coronidium rupicola* – zone of dehiscence of pappus; D. *Coronidium telfordii* – cypsela (note almost opaque pericarp); E. *Coronidium elatum* subsp. *vellerosum* – immature cypsela with partial dehiscence of pappus; F. *Coronidium boormanii* – surface view of pericarp of cypsela showing paired idioblasts. Scale bars = 0.2 mm.

Xerochrysum leucopsideum group

Median involucral bracts: claw oblong; stereome with a single vein that passes into the lamina.

Cypsela: truncate, pericarp crustaceous, smooth, not extending around base of pappus; bristles united at base and deciduous as a whole or persistent.

Idioblasts: not present.

Plants: rhizomatous.

Coronidium oxylepis group

Median involucral bracts: claw semi-terete to linear and thick, 1-nerved, the nerve extending into the lamina.

Cypsela: truncate, pericarp very thin and transparent; pappus arising from margin of apex, bristles free and persistent or deciduous, or united in a ring at base and breaking evenly a short distance above base to leave a short, almost truncate crown on the cypsela.

Idioblasts: laterally paired, linear to elliptic.

Plants: not rhizomatous

Coronidium elatum group

Median involucral bracts: claw semi-terete to linear and thick, 1-nerved, the nerve extending into the lamina.

Cypsela: truncate, pericarp crustaceous and opaque, epicarp cells with cuticular sculpturing (and in *C. elatum* with scattered micropapillae); pappus arising from margin of apex, bristles free, either deciduous or persistent and then fracturing unevenly towards base to leave a frayed margin.

Idioblasts: laterally paired, linear to elliptic.

Plants: not rhizomatous.

Coronidium scorpioides group

Median involucral bracts: claw semiterete and thick, 1-nerved, the nerve extending into the lamina.

Cypsela: truncate, pericarp very thin and transparent; pappus arising from margin of apex, bristles very shortly united at base and breaking unevenly a short distance above it to leave a frayed edge.

Idioblasts: laterally paired, linear.

Plants: rhizomatous.

Coronidium

Coronidium Paul G.Wilson, *gen. nov.*

Herbae perennes. Capitula pro parte maxima homogama, multiflora, discoidea. Receptaculum plus minusve planum, epaleatum. Bracteae involucrali multiseriatae, scariosae, laminis radiato-patentibus; unguibus bractearum medius et intimus semi-teretibus vel linearibus, nervo solitarius in laminam extenso, stereomate indiviso. Flosculi plerumque hermaphroditi; corolla tubulosa; antherorum caudae graciles; styli rami graciles, apice rotundato vel triangulari vel attenuato. Cypselae cylindricae; pericarpium 2-nervosum, crustaceum vel membranaceum, fulvum vel hyalinum; testa pallido brunea. Pappo setae filiformes, denticulatae, interdum supra basin facile ruptae et calyculum brevem dentatum supra cypselam reliquum.

Typus: *Corinidium oxylepis* (F.Muell.) Paul G.Wilson (*Helichrysum oxylepis* F.Muell.)

Helichrysum sect. *Helichrysum* ser. *Chrysolepidea* [subser.] *Oxlepidea* DC., *Prodr*. 6: 190 (1838). *Type*: not designated (containing only *H. collinum* and *H. rupicola* which are here recognised as conspecific).

Helichrysum sect. *Blepharolepis* [informal group] *Argyrolepis* DC., *Prodr.* 6: 193 (1838) *p.p. min.* (containing *H. elatum*, *H. lanuginosum*, and several other species not recognised as being in *Coronidium*).

Helichrysum sect. *Oxylepis* Benth., *Fl. Austral*. 3: 614, 623 (1867). *Type*: *Helichrysum oxylepis* F.Muell.

Perennial herbs. *Capitula* predominantly homogamous, discoid, rarely heterogamous, disciform. *Receptacle* ± flat, epaleate. *Involucral bracts* multiseriate, scarious, spreading when mature; claw of intermediate and inner bracts semi-terete to linear or narrowly oblong, cartilaginous, nerve solitary and extending into the lamina, stereome undivided. *Florets* bisexual or rarely some outer florets female; corolla narrowly cylindrical, broadened above, lobes short, ovate, nerves extending to base or to apex of lobes; *anther tails* slender, equal to or exceeding collar, appendage ovate, outwardly concave; style arms slender; style apex truncate, rounded, ovate, triangular or attenuate, strongly papillose. *Cypsela* cylindrical or oblongoid; pericarp two-veined, either crustaceous, opaque and brown to fawn, or very thin and transparent, smooth, glabrous, with laterally paired linear or elliptic clear cells (idioblasts); testa brown, epidermal cells oblong, somewhat curved or straight, mostly with transverse sinuate thickening; *carpophore* tumid, glossy, of *c.* 3 rows of thickened cells. *Pappus bristles* filiform, denticulate, smooth towards base where united in a persistent ring and breaking a short distance above it, or free and persistent, or deciduous as a whole.

Chromosome number. The only published chromosome count is that for *C. scorpioides*, n = 24 (Watanabe *et al.* 1999), however, B.L. Turner, *in sched.*, recorded n = 14 for *C. oxylepis* (*B.L. Turner* 5625 and 5612).

Notes. The laterally paired, clear, normally myxogenic cells that are found in the outermost layer of the pericarp in *Coronidium* are referred to as idioblasts. In the superficially similar genus *Anemocarpa* the idioblasts are vertically paired, i.e. one cell is placed above the other.

Etymology. Derived from the Greek words *korone* a crown, and the diminutive *-idion*, with reference to the short pappus crown that in the *C. oxylepis* group of species remains on the cypsela after the pappus bristles have broken near their base and fallen away.

A genus of 17 species endemic to eastern Australia except for two that are also found in south-eastern South Australia of which one extends into Tasmania.

1. Medial involucral bracts elliptic or lanceolate, smooth, white to yellow
2. Medial involucral bracts very narrowly lanceolate, straw-coloured to dusky yellow
3. Capitulum obviously woolly outside
4. Branches with a solitary, terminal, densely woolly capitulum; involucral bracts curled at anthesis............**2. C. rupicola**
4: Branches bearing several sparsely to moderately woolly capitula; involucral bracts not curled at anthesis
5. Leaves glabrous above, involucral bracts serrulate............**3. C. cymosum**
5: Leaves somewhat woolly above, involucral bracts with entire margin............**4. C. fulvidum**
3: Capitulum not or scarcely woolly outside
6. Leaves glabrous or sparsely cottony above............**1. C. oxylepis**
6: Leaves woolly all over............**5. C. lanosum**
2: Medial involucral bracts narrowly elliptic, white to pink or yellow
7. Medial involucral bracts white to pink
8. Leaves linear
9. Subtending herbaceous bracts distinctly separated from involucre; outermost involucral bracts shortly stipitate; cypsela with thin transparent pericarp (testa brown); pappus bristles breaking shortly above the persistent base (Qld).....**7. C. glutinosum**
9: Subtending herbaceous bracts not separated from involucre; outermost involucral bracts sessile; cypsela with crustaceous, opaque, reddish brown pericarp obscuring testa; pappus bristles persistent or deciduous intact (S.A., Vic., N.S.W.)
10. Leaves variably woolly below (Vic., N.S.W.)............**16. C. waddelliae**
10: Leaves with sessile or shortly stipitate glandular hairs below (S.A., Vic.).....**15. C. adenophorum**
8: Leaves ovate to obovate
11. Outer involucral bracts with a prominent semiterete claw
12. Leaves glandular-papillose, not woolly; pericarp crustaceous, dark reddish brown (N.S.W.)............**11. C. boormanii**
12: Leaves (at least the lower) somewhat woolly; pericarp thin, transparent (Qld)............**8. C. lanuginosum**
11: Outer involucral bracts sessile or subsessile and obscured by wool
13. Leaves congested, narrowly elliptic, felty below, margin flat or recurved.......**14. C. lindsayanum**
13: Leaves scattered, elliptic to broadly elliptic, flat, woolly below
14. Leaves eventually glabrous and dull above; capitula solitary or in panicles
15. Leaves elliptic, pinnately veined, indumentum white............**12. C. elatum**

15: Leaves ovate to elliptic, 3-nerved from near base, indumentum yellowish grey .... **13. C. telfordii**

14: Leaves ± woolly above and below; capitula solitary on stems

16. Leaves crowded towards base of plant, narrowly elliptic; pappus bristles persistent in intact state .... **10. C. kaputaricum**

16: Leaves scattered, narrowly to broadly elliptic; pappus bristles breaking just above a persistent base .... **9. C. newcastlianum**

7: Medial involucral bracts yellow .... **6. C. flavum**

1: Medial involucral bracts oblanceolate, apically wrinkled, yellow .... **17. C. scorpioides**

Coronidium oxylepis group [species 1–9]

Style apex rounded to acuminate. Cypsela cylindrical or oblongoid; pericarp very thin and transparent, smooth, glabrous, with laterally paired, linear or elliptic, clear idioblasts; testa brown, epidermal cells narrowly oblong, somewhat curved or straight. Pappus bristles filiform, denticulate, smooth and thickened towards base, sometimes united in a persistent ring and breaking a short distance above base to leave an apical corona on cypsela.

Notes. The pappus bristles of the species in this group are fused to each other for about the first 0.03 mm and readily break about 0.15 mm above their base. At the zone of dehiscence the cells of the bristle are quadrate and are only loosely attached to neighbouring cells while above and below this zone the cells of the bristle are narrowly oblong to linear and are firmly fused together.(Figure 1A, B, C)

1. **Coronidium oxylepis** (F.Muell.) Paul G.Wilson, *comb. nov.*

Helichrysum oxylepis F.Muell., *Fragm.* 1: 35(1858). – *Helichrysum collinum* DC. var. *oxylepis* (F.Muell.) Maiden & Betche, *Census New South Wales Pl.* 202 (1916). *Type*: Moreton Island, Qld, August 1855, *F. Mueller* (*holo:* MEL 1586000; *iso*: NSW).

[*Helichrysum collinum auct. non* DC.: Benth., *Fl. Austral.* 3: 623 (1867) *p.p.*; J. Everett in G.J. Harden, *Fl. New South Wales* 3: 232 (1992).]

Illustration. Harden (1992) p. 232 as *Helichrysum collinum.*

Perennial *herb* with woody rootstock, to 60 cm high; branches woolly or rarely glandular-puberulous or glabrous. *Leaves* linear to obovate, chartaceous to somewhat fleshy, to 7 cm long, obtuse to acuminate, sessile or narrowly cuneate at base, glabrous to sparsely cottony above, densely cottony to glabrous below. *Peduncle* slender. *Capitula* solitary, hemispherical, *c.* 3 cm diam. *Involucral bracts* yellow to straw-coloured, scarious; *outer bracts* somewhat loosely arranged, linear-acuminate, with glandular-puberulous green claw, in all *c.* 3 mm long; intermediate bracts with narrow-lanceolate acuminate yellow limb 6–10 mm long, becoming reflexed at maturity, claw terete *c.* 3 mm long; innermost bracts linear-acuminate *c.* 5 mm long. Style appendage very narrowly triangular. *Cypsela c.* 1.3 mm long; *pericarp* thin, transparent, with linear idioblasts; testa brown, the narrow cells transversely thickened. *Pappus bristles* filiform, denticulate, united at base, breaking shortly above base. Chromosome number n = 14, *fide B.L. Turner* 5625 and 5612 *in sched.*

Distribution and habitat. Found in south-east Queensland and in eastern New South Wales. The coastal populations mostly occur on deep sand while those inland have been collected from a variety of substrates.

Notes. Bentham (1863) considered that this species and *H. rupicola* (referred by Bentham to *H. collinum*) were closely related, while Maiden and Betche (1916) made *H. oxylepis* a variety of *H. collinum*; subsequent treatments have continued to treat them as conspecific. The two taxa are, however, clearly distinct and their distributions do not overlap (see also under *C. rupicola*).

Three subspecies are recognised.

1. Stem woolly, at least towards apex; leaves narrowly oblong or elliptic, sparsely to densely woolly
  2. Leaves narrowly oblong, sessile, sparsely cottony to almost glabrous .... **1a.** subsp. **oxylepis**
  2: Leaves narrowly ovate to narrowly obovate, narrowed at base, cottony to woolly....... **1c.** subsp. **lanatum**
1: Stem glabrous or minutely glandular-puberulous; leaves narrowly obovate to obovate, succulent, glabrous or almost so... **1b.** subsp. **carnosum**

1a. Coronidium oxylepis (F.Muell.) Paul G.Wilson subsp. oxylepis

Erect *perennial* to 0.5 m high. *Stem* woolly, densely so towards apex. *Leaves* often densely clustered towards base, scattered above, narrowly oblong to linear, acuminate, sparsely cottony or rarely glabrous. *Capitulum* receptacle glandular-puberulous between the involucral bracts. *Involucral bracts* with the stipe glandular-puberulous.

Distribution and habitat. A coastal or near-coastal plant that occurs in south-east Queensland south of Caloundra and in north-east New South Wales north of Yamba, growing in sandy situations.

Specimens examined. QUEENSLAND: Caloundra, *S.T. Blake* 4006 (BRI); Ipswich, *T.F. Hall* 225 (BRI); Peregian, *B.L. Turner* 5625 (BRI); Moreton Island, Sep. 1908, *C.T. White* (BRI). NEW SOUTH WALES: 1.6 km N of Pottsville, *R. Coveny* 4402 (BRI, NSW); *c.*1 mile (*c.* 1.6 km) S of Byron Bay, *R.D. Hoogland* 11669 (CANB); 4 miles (*c.* 6.5 km) S of Yamba, *D.J. McGillivray* 2137 (NSW); between Evans Head and Iluka, *D.J. McGillivray* 2702 (NSW); 5 km S of Sandon (NSW).

The typical variant of this subspecies, from the Moreton Bay district, has a slender stem with scattered linear leaves that are sparsely cottony. The variant found further south, particularly that found in north-east New South Wales, has a short stem with firm, linear, glabrescent leaves that are congested towards the base of the plant. There appears to be no disjunction between between the extremes of the two variants.

Mueller in his original description noted that the plant was found growing in coastal sand and that it had a mild fragrance.

This subspecies grades into subsp. *carnosum* to the north while to the south and inland it grades into subsp. *lanatum.*

1b. **Coronidium oxylepis** subsp. **carnosum** Paul G.Wilson, *subsp. nov.*

Planta prostrata vel decumbens; caules infra capitulum minute glanduloso-puberuli aliter glabri. Folia dispersa, anguste oblongo-obovata vel obovata, aliquantum succulenta, glabra, 1.5–5 cm longa, ad basim attenuata, ad apicem obtusa vel rotundata, apiculata.

Typus: Fraser Island, Eli Creek, on eastern side of island, sandy dune on northern side of creek, 3 May 1967, *P. Baxter 813* (*holo*: BRI [AQ 248463])

Prostrate to decumbent *perennial*. *Stems* minutely glandular-puberulous below capitulum, otherwise glabrous. *Leaves* scattered, narrowly oblong-obovate to obovate, 1.5–5 cm long, narrowed towards base, obtuse to rounded and apiculate at apex, somewhat succulent, glabrous.

Distribution and habitat. Occurs on the south-east coast of Queensland between Noosa and Fraser Island. It is frequently found growing in deep sand, often on dunes.

Selected specimens examined. QUEENSLAND: Fraser Island, *P. Baxter* 805 (BRI); Teewah, N. of Noosa Heads, 17 Jan. 1965, *H. Doing s.n.*(CANB); Sunshine Beach, Wide Bay district, 2 Mar. 1975, *P. Richter s.n.* (BRI); Lake Cootharaba, 1911, *J. Keys s.n.* (BRI).

1c. **Coronidium oxylepis** subsp. **lanatum** Paul G.Wilson, *subsp. nov.*

Planta erecta vel decumbens ad 60 cm alta. Rami, praecipue ad apicem, lanosi. Folia anguste elliptica, acuminata, ad 8 cm longa, sursum deminuens, ad basim variabiliter angustata, subter sparse vel dense lanosa, supra glabra vel sparse lanosa.

Typus: 12 miles (*c.* 19 km) N of Glenhaughton HS, Leichhardt District, Queensland, 14 October 1963, *N.H. Speck* 1849 (*holo*: CANB 137894).

Erect or decumbent *perennial* to 60 cm high. *Branches* woolly, densely so towards apex. *Leaves* narrowly elliptic, acuminate, to 8 cm long, diminishing upwards, variably narrowed at base, sparsely to densely woolly below (rarely glabrescent), glabrous or sparsely woolly above. (Figure 2)

Distribution and habitat. Found in south-eastern Queensland and eastern New South Wales. Often growing on granite or sandstone in eucalypt forest.

Selected specimens examined. QUEENSLAND: 18.2 km W of Westmar, Moonie Hwy, *P.I. Forster* 1911 (BRI); Palmgrove National Park, Bigge Range, *P.I. Forster* 23702 & *R. Booth* (AD, BRI). NEW SOUTH WALES: 27 km E of Tenterfield on Casino Rd, *N.S. Lander* 542 (NSW); 67 miles [*c.*100 km] N of Windsor on hwy to Singleton, *B.L. Turner* 5612 (MEL). A.C.T.: O'Connor, *H.S. McKee* 7521 (CANB).

Notes. A subspecies that possibly should be recognised as more than one taxon. The density of the indumentum, the leaf shape, and the habit show variation but with no clear delineation between the different variants.

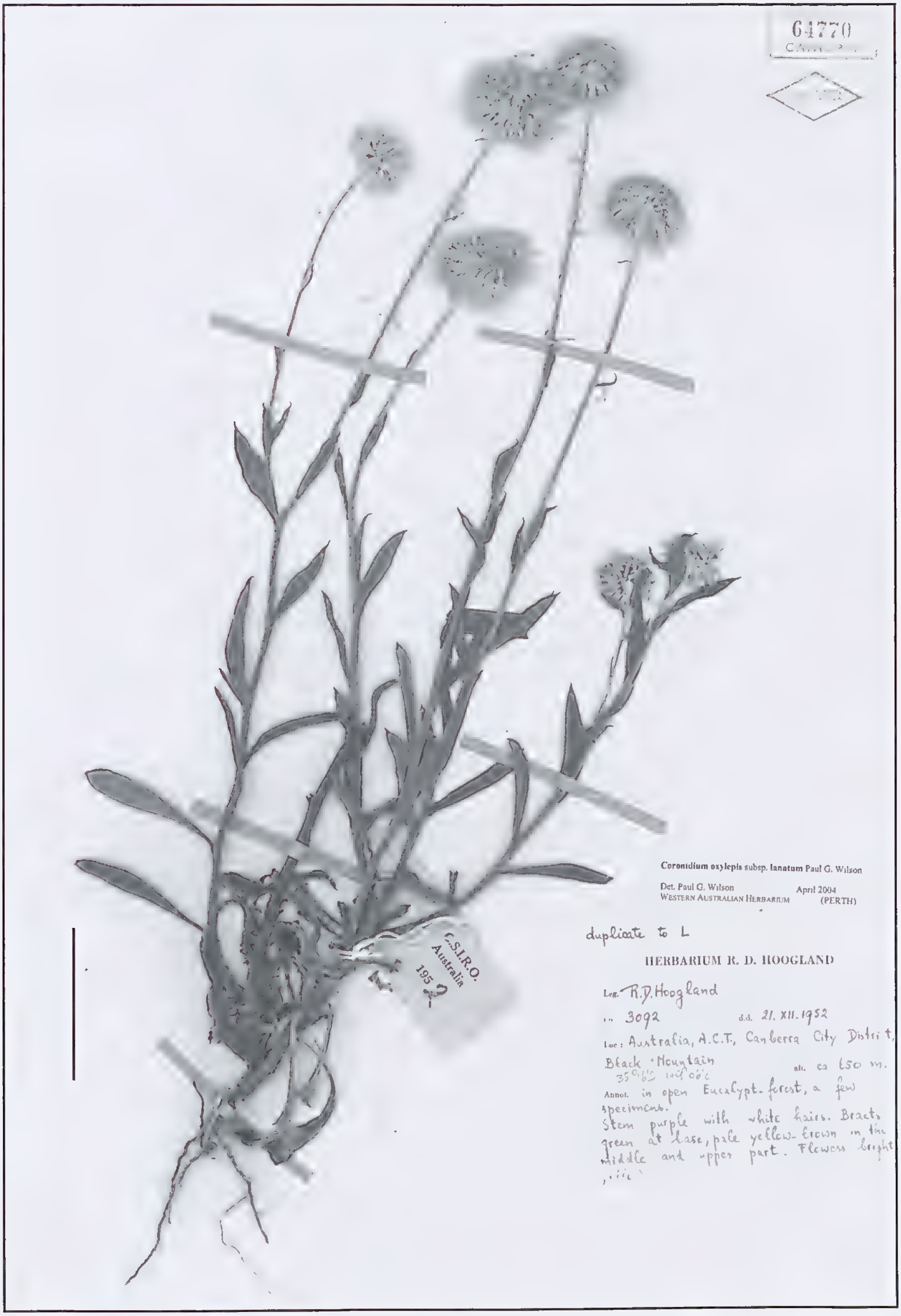

64770
Coronidium oxylepis subsp. lanatum Paul G. Wilson
Det. Paul G. Wilson April 2004
WESTERN AUSTRALIAN HERBARIUM (PERTH)
duplicate to L
HERBARIUM R. D. HOOGLAND
Leg. R.D. Hoogland
3092 d.d. 21. XII. 1952
Loc: Australia, A.C.T., Canberra City District, Black Mountain alt. ca 650 m.
35°16'S 149°06'E
Annot. in open Eucalypt. forest, a few specimens.
Stem purple with white hairs. Bracts green at base, pale yellow-brown in the middle and upper part. Flowers bright
C.S.I.R.O. Australia 195

Figure 2. *Coronidium oxylepis* subsp. *lanatum* (*R.D. Hoogland* 3092, CANB 64770), scale = 5 cm.

2. Coronidium rupicola (DC.) Paul G.Wilson, *comb. nov.*

Helichrysum rupicola DC., *Prodr*. 6: 190 (1838); *Gnaphalium rupicola* (DC.) Sch.Bip., *Bot. Zeitung* 3: 171(1845). *Type*: Cape Cleveland, Queensland, June 1819, *A. Cunningham* 267 (*holo*: G-DC microfiche photo seen; *iso*: MEL 1585998, CANB 00436696).

Helichrysum collinum DC., *Prodr*. 6: 190 (1838); *Gnaphalium endeavourense* Sch. Bip., *Bot. Zeitung* 3:171 (1845). *Type*: 'Hills on the Shores of Endeavour River & Port Bowen'[= Port Clinton], Queensland, 1820, *A. Cunningham* 90 (*holo*: G-DC microfiche photo seen; ?*iso*: K, 'bare hills in the neighb[ourhoo]d of Endeavour River, N.S.Wales', 28 July 1820, *A. Cunningham*).

Helichrysum rupicola var. *danesii* Domin, *Biblio. Bot*. 89:671(1929). *Type*: Walsh Pyramid, Queensland, January 1910, *J.Danes* (*holo*: PR 531623, photo seen).

Illustration. Pearson & Pearson (199-) p. 221 (199-) as *Helichrysum rupicola*.

Subshrub to 50 cm high. *Branches* woolly. *Leaves* narrowly elliptic, acuminate, to 10 cm long, flat, woolly below, sparsely cottony to glabrous above. *Peduncles* slender, woolly. *Capitula* solitary, depressed globular, dense, *c.* 2 cm diam., woolly around base. *Involucral bracts* scarcely exceeding florets; claw woolly, semi-terete; lamina ciliate to entire; outer bracts: lamina linear-filiform; intermediate: lamina linear-acuminate *c.* 6 mm long yellow, curled and reflexed at maturity; innermost: laminae short, erect, linear-acuminate. *Outermost florets* occasionally female. *Anther* appendage triangular, *c* .0.3 mm long. *Style* appendage ovate to narrowly ovate. *Cypsela c.* 1.3 mm long; pericarp thin, transparent with linear idioblasts; testa brown, the narrow cells transversely thickened. *Pappus* bristles filiform, denticulate, united at base and breaking shortly above it.

Distribution and habitat. Found in far north-east Queensland where it grows in open eucalypt forest, savanah woodland, and on exposed ridges.

Selected specimens examined. QUEENSLAND: 9.5 km E of Tully, *D.E. Boyland* 561 (BRI); Big Tableland, *c* .27 km S by E of Cooktown, Daintree National Park, *P.I. Forster* 22758 (MEL); Mt Graham, *D. Halford* Q312 (BRI); *L.S. Smith* 11198 (CANB).

Note. On Hinchinbrook Island in Rockingham Bay, Queensland, occurs a variant with glabrous or almost glabrous leaves. This variant is known from two collections: *P. Sharpe* 1665, 'near cliff edge' (BRI), and *J. Dallachy*, November 1867, 'common all over the Plain' (MEL). These two collections show marked morphological dissimilarities which is possibly due to the differences in exposure experienced by the plants at the different sites.

3. Coronidium cymosum Paul G.Wilson, *sp. nov.*

Rami graciles, lanati. Folia anguste elliptica, plerumque 4–9 cm longa, infra lanata, supra glabra vel glabriuscula. Pedunculi graciles, ab axilis foliorum et bractearum orientibus. Capitula subglobularia, *c.*2 cm diam.; bracteae sparse vel modice lanatae, exterioribus anguste ellipticae, interioribus ungue applanato vel semitereti, lamina anguste triangulari-acuminata, pallido lutea.

Typus: Blackdown Tableland, *c.* 35 km SE of Blackwater, Queensland, 3 September 1971, *R.J. Henderson, L. Durrington & P. Sharpe* 948 (*holo*: BRI [AQ 00014196]; *iso*: CANB 303554, MEL 2111963).

Erect *annual or perennial herb* to 1.5 m high, usually single-stemmed. *Branches* slender, woolly. *Leaves* narrowly elliptic, narrowed to a short petiole, mostly 4–9 cm long, woolly beneath, glabrous or glabrescent above. *Peduncles* slender, arising from the axils of the upper leaves or bracts. *Capitula* not subtended by foliaceous bracts, subglobular, *c.* 2 cm diam.; bracts congested, sparsely to moderately woolly, outer narrowly elliptic; inner with flattened to semiterete claw and narrowly triangular-acuminate, pale yellow, serrulate lamina that may become reflexed when mature, in all to 7 mm long. *Style* apex slender acuminate. *Cypsela c.* 1.3 mm long; pericarp thin, transparent with linear idioblasts; testa brown, the narrow cells transversely thickened. *Pappus bristles* filiform, denticulate, united at base and breaking shortly above it. (Figure 3)

Distribution and habitat. Found in coastal north-east Queensland and on the Blackdown Tableland. It grows on coastal dunes and in sandy soil in open forest or on sandstone ridges.

Selected specimens examined. QUEENSLAND: South Percy Island, *G.N. Batianoff* 11468 (BRI); 6.3 km S of Horseshoe Lookout, Blackdown Tableland National Park, *P.C. Jobson* 4970 (MEL); Shoalwater Bay Military Res., *P.R. Sharpe* 5533 (BRI).

Etymology. The specific epithet is derived from the cymose appearance of the inflorescence.

Notes. This species is readily distinguished from *C. rupicola* by the slender peduncles which arise from the axils of the upper leaves or cauline bracts, by the glabrous or weakly woolly capitula, and by the erect involucral bracts that may become reflexed, but not revolute, at maturity.

4. Coronidium fulvidum Paul G.Wilson, *sp. nov.*

Rami graciles, lanati. Folia anguste elliptica, plerumque 4–9 cm longa, infra dense lanata, supra sparse lanata vel glabrescentia. Pedunculi graciles, terminales. Capitula subglobularia, 2.5–3 cm diam.; bracteae confertae fulvidae; exterioribus ungue anguste oblongo crasso lanoso 2 mm longo, lamina anguste elliptica nitida *c.* 4 mm longa; mediales ungue semitereti lanoso *c.* 4 mm longo, lamina anguste elliptica acuminata undulata, nitida demum reflexa.

Typus: Near Herberton, Anniversary Falls, Cook district, Queensland, 22 May 1989, *D.L. Jones* 4217 *& M.A. Clements* (*holo*: CANB (CBG 8913021); *iso*: BRI *n.v.*, MEL274574).

Erect branching *perennial herb* to 1 m high. *Branches* slender, woolly. Leaves narrowly elliptic, subsessile, mostly 4–9 cm long, woolly beneath, sparsely woolly or glabrescent above. *Peduncles* slender, terminal to branches. *Capitula* not subtended by foliaceous bracts, subglobular, 2.5–3 cm diam.; bracts compact, pale yellowish brown; outer with narrowly oblong woolly claw *c.* 2 mm long and narrowly elliptic, glossy, sparsely woolly lamina *c.* 4 mm long; medial with semi-terete woolly claw *c.* 4 mm long and narrowly elliptic acuminate undulate glossy lamina *c.* 7 mm long with smooth margin, becoming reflexed and somewhat curled with age; innermost with narrowly oblong woolly claw and narrowly triangular lamina, in all to 6 mm long. *Corolla* narrowly cylindrical, becoming narrowly turbinate above, *c* .4.5 mm long, yellow. *Style* apex ovate, acute. *Cypsela* not seen in mature state. Pappus bristles filiform, denticulate, dehiscing shortly above base.

Distribution and habitat. Only known from the Herberton Range in the Cook district of Queensland where it is recorded as growing on rocky slopes in open eucalypt forest.

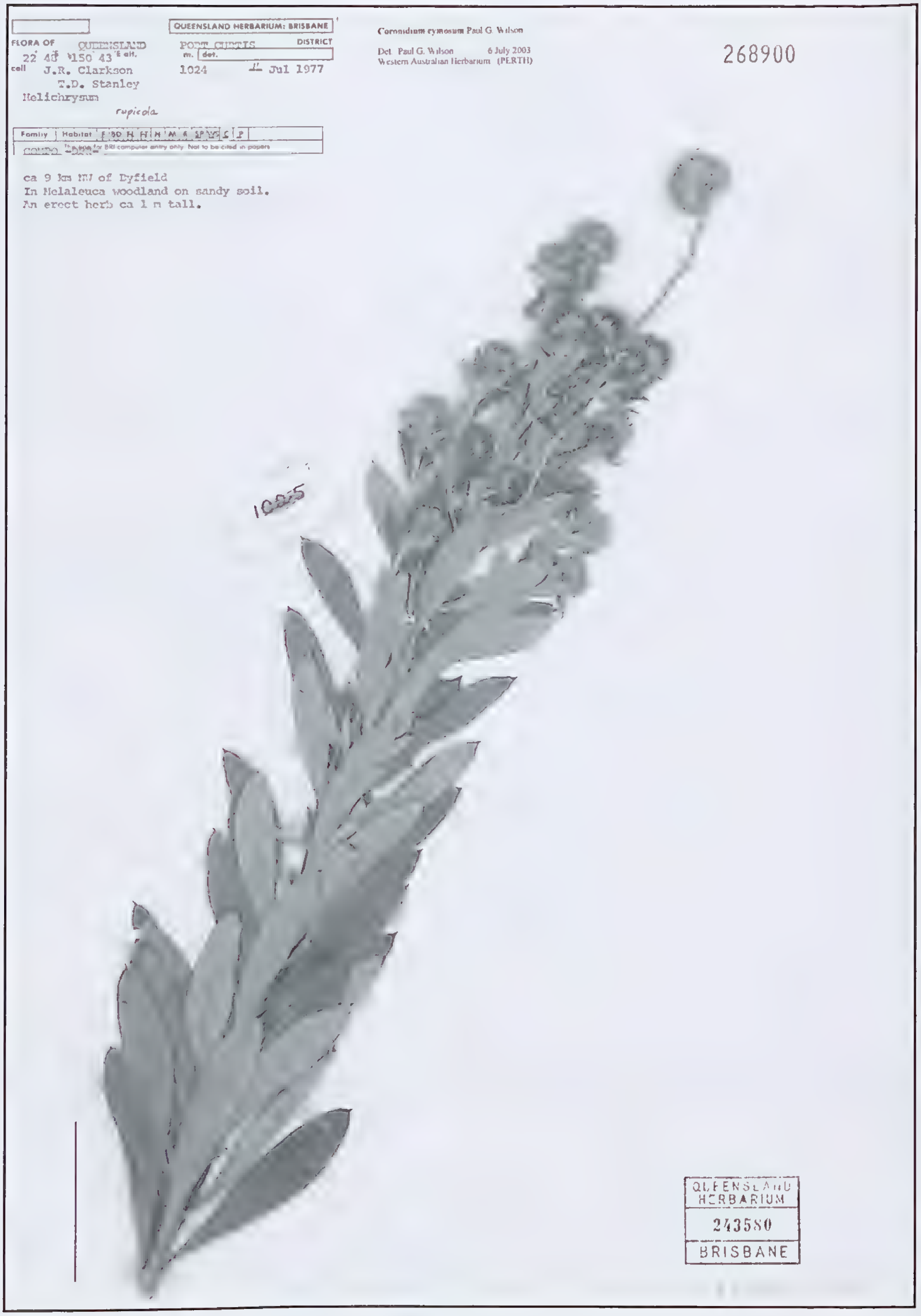

QUEENSLAND HERBARIUM: BRISBANE
FLORA OF QUEENSLAND
PORT CURTIS DISTRICT
22 48 150 43
J.R. Clarkson
T.D. Stanley
1024
Jul 1977
Helichrysum
rupicola
Family Habitat
This line for BRI computer entry only. Not to be cited in papers
ca 9 km NW of Dyfield
In Melaleuca woodland on sandy soil.
An erect herb ca 1 m tall.
Coronidium cymosum Paul G. Wilson
Det. Paul G. Wilson 6 July 2003
Western Australian Herbarium (PERTH)
268900
10025
QUEENSLAND HERBARIUM
243580
BRISBANE

Figure 3. *Coronidium cymosum*. (*J.R. Clarkson & T.D. Stanley* 1024, AQ 268900), scale = 5 cm.

Additional specimen examined. QUEENSLAND: Herberton Range, *I.R. Telford* 12167 (CANB).

Etymology. The specific epithet alludes to the dull yellowish brown colour of the involucral bracts.

Notes. This species may be distinguished from *C. rupicola*, with which it has been confused, by the much longer and more obvious involucral bracts.

5. Coronidium lanosum Paul G.Wilson, *sp. nov.*

Rami graciles, lanati. Folia dense lanata, anguste elliptica ad elliptica vel obovata, 2–4 cm longa, obtusa vel acuta, apiculata, basim cuneata. Capitula *c.* 1 .5 cm diam., solitaria, in pedunculis gracilibus remote bracteatis posita. Involucrum bracteae compactae; bracteae intermediae lamina lutea, glabra, anguste oblongo-acuminata, integra, glabra, nitida, *c.* 3 mm longa, demum ad medium reflexa, ungue gracili, semi-tereti, *c.* 2.5 mm longi, glanduloso-hirsuti.

Typus: Mt King, *c.* 96 km NNE of Hughenden, Queensland, 1 April 1998, *E.J. Thompson* HUG692 (*holo*: BRI [AQ 573739]).

Helichrysum sp. (Belyando River *V.J. Nelder* 3459), Queensland Herbarium, *Queensland vascular plants* 39 (1994).

Short-lived, branching, *perennial herb* to 40 cm high. Branches slender, woolly. *Leaves* densely woolly, narrowly elliptic to elliptic or obovate, 2–4 cm long, obtuse to acute, apiculate, cuneate at base. *Capitula c.* 1.5 cm diam., not subtended by leafy bracts, solitary on remotely bracteate slender peduncles. *Involucral bracts* compact, yellow, glabrous apart from the semi-terete glandular-hirsute claw; *outer bracts* ovate-acuminate, minutely denticulate; intermediate bracts with slender claw *c.* 2.5 mm long and narrowly oblong-acuminate entire, glabrous, glossy lamina *c.* 3 mm long, becoming medially reflexed at maturity. *Anther* appendage narrowly triangular, 0.4 mm long. *Style* apex ovate to acuminate. *Cypsela c.* 1.3 mm long; pericarp thin, transparent with linear idioblasts; testa brown, the narrow cells transversely thickened. *Pappus bristles* filiform, denticulate, united at base and breaking shortly above base. (Figure 4)

Distribution and habitat. Found in north-central Queensland where it is recorded as growing on volcanic rock in open woodland.

Selected specimens examined. QUEENSLAND: head of Flinders River, *anon.* 189 (MEL); near source of Poison Creek, *S.T. Blake* 8548 (BRI); Mt Sturgeon Station, *C.E. Hubbard & C. Winders* 7574 (BRI); 14.8 km N of Belyando River Crossing, *V.J. Nelder* 3459 (BRI).

Etymology. The epithet *lanosum* refers to the woolly indumentum that covers the branches and leaves.

Notes. A plant that is similar to *C. lanosum* is found in the Many Peaks Range, Queensland. It differs from *C. lanosum* in having leaves that are sparsely woolly above (not densely woolly) and in having involucral bracts with claws that are moderately woolly (not glandular-hirsute). It is only known to me from one collection, *I.R. Telford* 12309 (CANB).

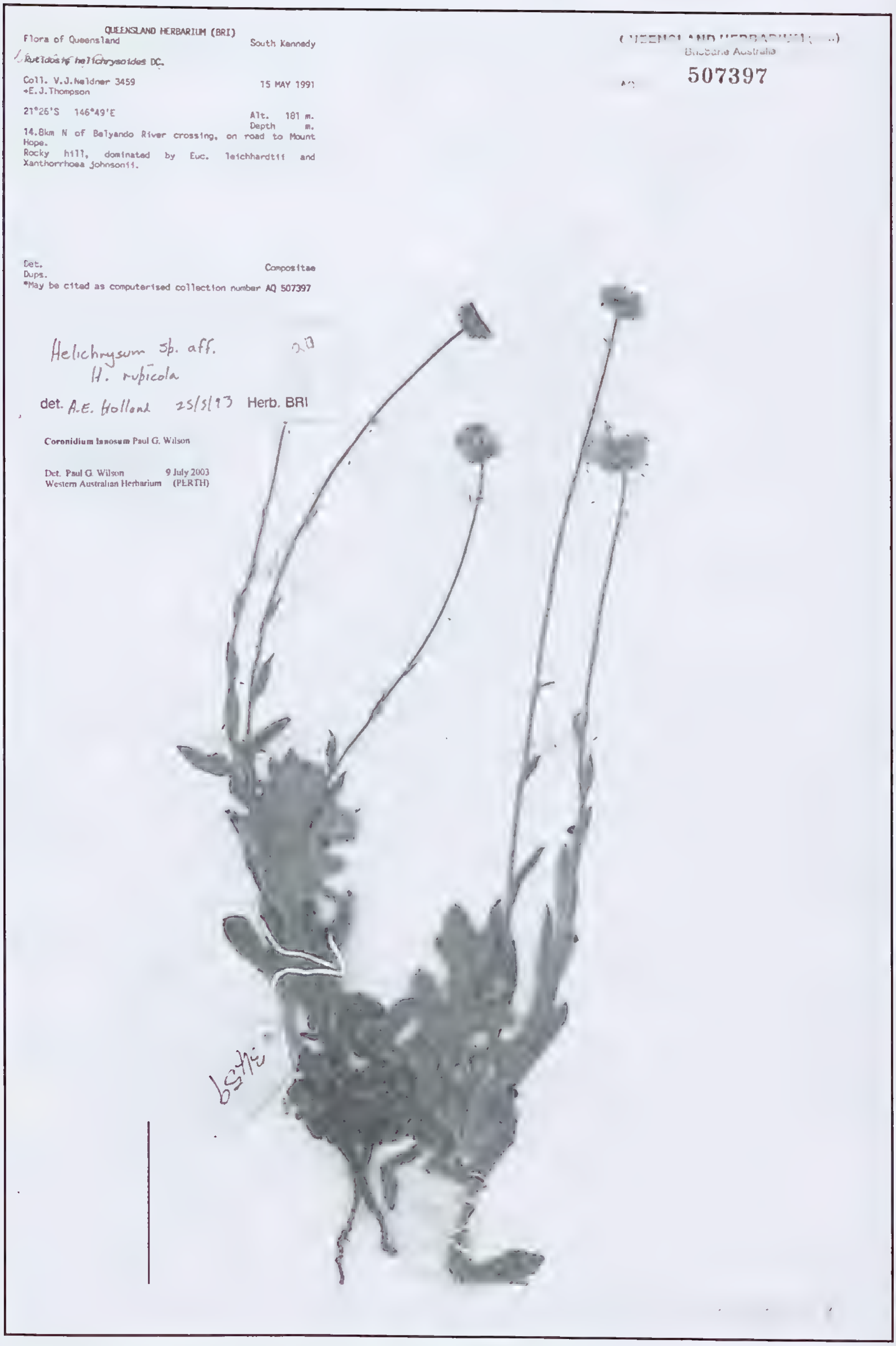

QUEENSLAND HERBARIUM (BRI)
Flora of Queensland
South Kennedy
Rutidosis helichrysoides DC.
Coll. V.J.Neldner 3459
+E.J.Thompson
15 MAY 1991
21°26'S 146°49'E
Alt. 181 m.
Depth m.
14.8km N of Belyando River crossing, on road to Mount Hope.
Rocky hill, dominated by Euc. leichhardtii and Xanthorrhoea johnsonii.
Det.
Dups.
Compositae
*May be cited as computerised collection number AQ 507397
Helichrysum sp. aff.
H. rupicola
det. A.E. Holland 25/5/93 Herb. BRI
Coronidium lanosum Paul G. Wilson
Det. Paul G. Wilson 9 July 2003
Western Australian Herbarium (PERTH)
Brisbane Australia
507397

Figure 4. *Coronidium lanosum*. (*V.J. Neldner* 3459, AQ 507397), scale = 5 cm.

6. **Coronidium flavum** Paul G.Wilson, *sp. nov.*

Rami graciles, simplices vel modice ramosi, lanati. Folia sessilia, anguste elliptica vel obovata, acuta, basim cuneata, 4–5 cm longa, infra dense et supra leviter lanata. Pedunculi graciles, ad 20 cm longi. Capitula solitaria, hemisphaerica, ad basim lanosa, *c.* 2.5 cm diam. Involucre bracteae compactae; bracteae intermediae lamina lutea, obovata, acuminata, integra, *c.* 6 mm longa, ungue semi-tereti, *c.* 3 mm longi, lanosi.

Typus: 18.5 km W of Paluma, Queensland, 22 October 1989, *P.C. Jobson* 967 (*holo*: MEL 223774; *iso*: BRI [AQ 481153], CANB 9103497).

Helichrysum newcastlianum var. Bluewater Creek (A.R. Bean 3784), R.J.F. in Henderson (ed.), *Names and distribution of Queensland plants, algae, and lichens* (2002).

Erect annual or short-lived *perennial* to 75 cm high. *Stem* simple or slightly branched, woolly. *Leaves* sessile, narrowly elliptic to obovate, acute, apiculate, cuneate at base, 4–5 cm long, woolly, less densely so above. *Peduncles* terminal to branches, slender, to 20 cm long, woolly. *Capitula* solitary, hemispherical, woolly around base, *c.* 2.5 cm diam.; outer involucral *bracts* woolly: claw terete *c.* 2 mm long, lamina linear-lanceolate, *c.* 4 mm long; median bracts: claw semi-terete, woolly, *c.* 3 mm long, lamina glabrous, elliptic to obovate, acuminate, *c.* 8 mm long, yellow. *Style appendage* narrowly ovate. *Cypsela c.* 1.3 mm long; pericarp thin, transparent with linear idioblasts; testa brown, the narrow cells transversely thickened. *Pappus bristles* filiform, denticulate, united at base and breaking shortly above it.(Figure 5)

Distribution and habitat. Found in north-east Queensland near Hidden Valley, *c.* 85 km north-west of Townsville, where it grows on rocky hillsides in eucalypt woodland.

Selected specimens examined. QUEENSLAND: Bluewater Ck Rd, *A.R. Bean* 3784 (BRI); between Paluma and Hidden Valley, *P.I. Forster* 9483 (BRI).

Etymology. The epithet *flavum* refers to the yellow colour of the involucral bracts.

Notes. *Coronidium flavum* differs most obviously from most of the other species in the genus in having yellow involucral bracts. It differs from *C. lanosum* in having larger leaves and capitula, and in having bracts that do not become reflexed at maturity.

7. **Coronidium glutinosum** (Hook.) Paul G.Wilson, *comb. nov.*

Helipterum (‘*Helipteres*’) *glutinosum* Hook. in Mitch., *J. Trop. Austral.* 361 (1848); *Helichrysum glutinosum* (Hook.) Benth., *Fl. Austral*, 3: 621(1867) *nom. illeg. non* A.Br. (1841); *Helichrysum elatum* var. *glutinosum* (Hook.) Moore & Betche, *Handb. Fl. N.S.W.* 281 (1893). *Type*: Depot Camp, [Maranoa R., near ‘Forest Vale’ homestead], Queensland, 31 August 1846, *T.L. Mitchell* (*holo*: K *n.v.*; ?*iso*: NSW 19138, *T.L. Mitchell* 315, Sep 1846).

Illustration. Pearson (199–) p. 220, as *Helichrysum glutinosum*

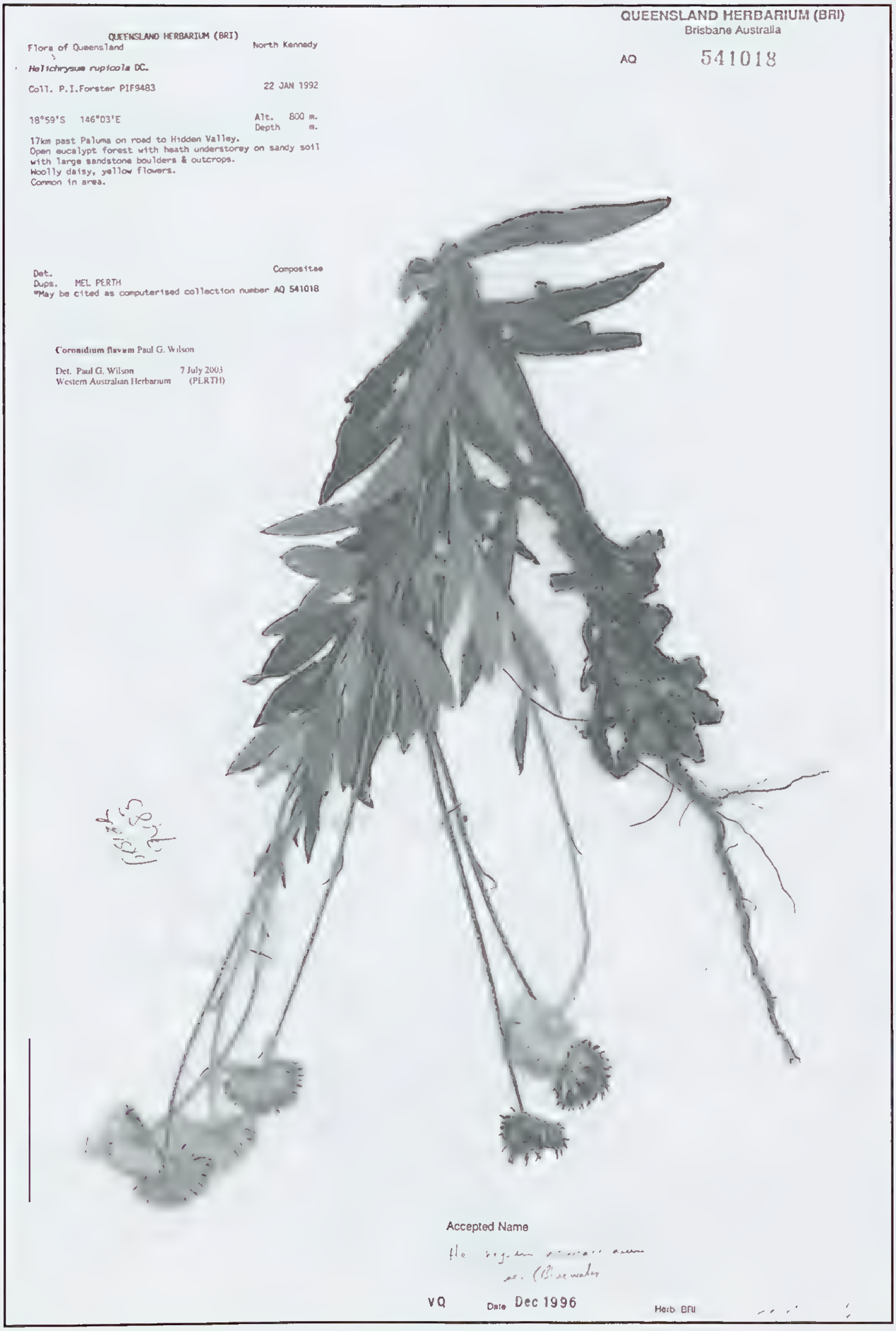

QUEENSLAND HERBARIUM (BRI)
Brisbane Australia
AQ 541018
QUEENSLAND HERBARIUM (BRI)
Flora of Queensland
North Kennedy
Helichrysum rupicola DC.
Coll. P.I.Forster PIF9483
22 JAN 1992
18°59'S 146°03'E
Alt. 800 m.
Depth m.
17km past Paluma on road to Hidden Valley.
Open eucalypt forest with heath understorey on sandy soil with large sandstone boulders & outcrops.
Woolly daisy, yellow flowers.
Common in area.
Det.
Compositae
Dups. MEL PERTH
*May be cited as computerised collection number AQ 541018
Coronidium flavum Paul G. Wilson
Det. Paul G. Wilson 7 July 2003
Western Australian Herbarium (PERTH)
Accepted Name
VQ
Date Dec 1996
Herb. BRI

Figure 5. *Coronidium flavum*. (*P.I.F. Forster* 9483, AQ 541018), scale = 5 cm.

Viscid, strongly aromatic *herb or subshrub* to 1 m high. *Branches* densely glandular-hispid, sparsely cottony. Lower *leaves* narrowly elliptic, acuminate, to 7 cm long, flat, densely woolly below, sparsely so above, upper leaves linear, acuminate, cottony or glandular below, glandular-hispid above, margin recurved to revolute. *Peduncles* with filamentous, glandular bracts. *Capitula* solitary, hemispherical, 3–4 cm diam., subtending herbaceous bracts distinctly separate; *outer involucral bracts* shortly stipitate: lamina very narrowly elliptic, acuminate, white to pale pink, claw narrowly oblong, *c.* 1.5 mm long, glandular-hirsute; intermediate bracts similar, claw semi-terete, in all to 15 mm long; innermost bracts very narrowly oblong, obtuse to acuminate, *c.* 7 mm long including the flattened claw, laminas reflexed at maturity. *Receptacle* prominently honeycombed. *Style appendage* ovate. *Cypsela c.* 1.3 mm long; pericarp thin, transparent with linear idioblasts; testa brown, the narrow cells transversely thickened. *Pappus* as in *C. oxylepis*.

Distribution and habitat. Found in north-central Queensland. Usually found growing on skeletal soil over sandstone, often in *Acacia* or eucalypt woodland.

Selected specimens examined. QUEENSLAND: 19.7 km E of Jericho, *A.D. Chapman* 1277 (BRI); Dawson Range, *M.D. Crisp* 3005 (CANB); Robinson Gorge National Park, *P.I. Forster* 11447 (BRI); Isla Gorge, *F.D. Hockings* 541 (BRI).

Note. This species is similar in appearance to *C. waddelliae*; however, in the latter the cypsela has a brown crustaceous pericarp with broadly elliptic idioblasts, and the pappus bristles are either persistent or tardily deciduous in an intact state.

8. Coronidium lanuginosum (A.Cunn. ex DC.) Paul G.Wilson, *comb. nov.*

Helichrysum lanuginosum A.Cunn. ex DC., *Prodr*. 6: 193 (1838); *H. albicans* Spreng. var. *lanuginosum* (DC.) Domin, *Biblioth. Bot*. 89: 668 (1929); *Gnaphalium stipitatum* Sch.Bip., *Bot. Zeitung* 3: 171 (1845) *non G. lanuginosum* Kunth (1820). *Type*: Rodds Bay, Queensland, May 1819, *A. Cunningham 110* (*holo*: G-DC microfiche photo seen; *iso* (as *A. Cunningham* 266): CANB 00436693).

Helichrysum boormanii var. *tryonii* Domin, *Biblioth. Bot*. 89: 670 (1929). *Type*: South Percy Island, Queensland, 5 March 1906, *H. Tryon* (*isosyn*: BRI 364942), Port Denison, Queensland, *E. Fitzalan* (*isosyn*: MEL 262825). Lectotype here selected: South Percy Island, 5 March 1906, *H. Tryon* (*isolecto*: BRI 364942).

Helichrysum boormanii var. *gillivrayi* Domin, *Biblioth. Bot*. 89:670(1929). *Type*: Queensland, Port Curtis, November 1847, *John MacGillivray*. 'Voyage of Rattlesnake, Botany No. 52.' (*holo*: *n.v.*).

[*H. elatum* var. *fraseri* Benth., *Fl. Austral*. 3: 621 (1867) *p.p.* as to the *J. MacGillivray* collection cited; *syn*: K *n.v.*, not as to lectotype.]

[*Helichrysum boormanii* Maiden & Betche, *Proc. Linn. Soc. New South Wales* 30: 366 (1905) *p.p.* as to the syntype: Atherton, Queensland, August 1901, *E. Betche* (*syn*: BRI 364944, NSW 519160), not as to lectotype, see *Notes*.]

Perennial herb to 1.5 m high. *Branches* glandular-puberulous or woolly. *Leaves* somewhat dense, elliptic to obovate, obtuse to acute or attenuate, apiculate, narrowly cuneate or stem-clasping at base, to 10 cm long, glabrous to glandular or woolly below, glabrous or glandular puberulous above. *Capitula* solitary or in an open leafy corymb, hemispherical, 3–6 cm diam. *Involucral bracts* white, limb very narrowly oblong-elliptic acuminate, all with semi-terete glandular, stipitate claws, lowermost loosely arranged and continuing down peduncle where grading into herbaceous, linear bracts. *Style* appendage narrowly triangular. *Cypsela* and *pappus* as in *C. oxylepis.*

Distribution and habitat. Endemic to northern and eastern Queensland, where usually found in rocky situations, sometimes on exposed rocky coasts.

Selected specimens examined. QUEENSLAND: Shaw Island., *G.N. Batianoff* 3219 (BRI); Keswick Island, *G.N. Batianoff* 9609289 (BRI); Arthur Point, *A.R. Bean* 2638 (BRI); 3.5 km N of Palmer River, *R.J. Cumming* 10766 (BRI); 20 miles [32 km] NE of Rockhampton, *S.L. Everist* 8009 (BRI); 1 km SW of Stones Hill, *P.I. Forster* 5604 (MEL); Stanage Point, *C.H. Gittins* 874 (BRI); 37 km from Paluma towards Ewan, *C. Gittins* 02522 (BRI); 3 miles [*c.* 5 km] N of Marlborough HS, *M. Lazarides* 6882 (CANB); Glen Geddes, *R.L. Specht* 351 (BRI); 15 km SE of Mareeba, *I.B. Staples* 240572/3 (BRI).

Notes. This species shows considerable morphological variation and occurs in a number of different habitats. It is likely that some of the variants will be found to warrant specific or infraspecific recognition.

Allan Cunngham recorded that he made the type collection at Rodds Bay on 30 May 1819; he gave it the number 266 after he had arranged his material in systematic order and this is the number that is on the label of the isotype in CANB. The number 110 on the holotype in G-DC may be a field number or it may have been applied subsequently, however, I consider that the two sheets represent the same collection.

A note by C.T. White (dated 7 March 1940) on the E. Betche syntype of *Helichrysum boormanii* in herb. BRI reads: ‘M & B in their original account of the species listed 2 collections, Atherton *E. Betche* & Boonoo Boonoo *J.L. Boorman*; though they distributed the latter as a type their description applies more especially to the Atherton plant & that’s the one I would regard as the type of the species.’ In spite of C.T. White’s note the name *C. boormanii, q.v.,* is here lectotypified on the *Boorman* collection as this was evidently the intention of Maiden and Betche. The cypsela of the Boorman collection is of the form found in the *C. elatum* group, while the cypsela of the Betche collection is of the form found in the *C. oxylepis* group, as also is the cypsela of *C. lanuginosum.*

9. Coronidium newcastlianum (Domin) Paul G.Wilson, *comb. nov.*

Helichrysum newcastlianum Domin, *Biblioth. Bot.* 89: 670 (1929). *Type*: Newcastle Range, Queensland, *s. dat. F. Mueller s.n.* (*iso*: MEL 2116945).

Perennial herb to 60 cm high with woody rootstock. *Branches* slender, densely woolly. *Leaves* sessile or short- to long-petiolate, narrowly oblong-elliptic to obovate, obtuse to acute, 3–7 cm long, densely woolly. *Peduncles* slender, 2–15 cm long. *Capitula* solitary, 3–4 cm diam., woolly at base, subtending bracts linear, obscure; *involucral bracts* compact, very narrowly oblong-elliptic, acute, white (or pink when young), outer sessile, intermediate with semi-terete claw woolly and glandular-hirsute, in all to 12 mm long; innermost similar, *c.* 4 mm long. Style appendage ovate. *Cypsela c.* 1.3 mm long; pericarp thin, transparent with linear idioblasts; testa brown, the narrow cells transversely thickened. *Pappus* as in *C. oxylepis.*

Distribution and habitat. Occurs in north-central and north-east Queensland where it is generally found growing in open eucalypt forests on skeletal soils in rocky situations.

Selected specimens examined. QUEENSLAND: 16 km NW of Mt Garnet, *A.R. Bean* 5471 (BRI); between Herberton & Watsonville, *L.J. Brass* 33604 (BRI); Mt Mulligan, *J.R. Clarkson* 5897 (BRI); 1.5 km W of Herberton, *B.J. Conn & J. Clarkson* 1144 (BRI, MEL); Millstream Falls turnoff, south of Herberton, *J.R. Maconochie* 2666 (BRI, CANB); Newcastle Range, 20 miles [*c.* 32 km] east of Forsayth, *N.H. Speck* 4705 (BRI); Herberton Range, *I.R. Telford* 11358 *& R.J. Rudd* (AD, MEL).

Notes. Coronidium newcastlianum differs from *C. lanuginosum*, with which it has been confused, in having a leaf lamina that is woolly all over and involucral bracts that are very congested. The median and inner involucral bracts have semi-terete claws while the outer are sessile and do not continue down onto the peduncle.

Coronidium elatum group [species 10–16]

Style apex rounded to acuminate. Cypsela: pericarp crustaceous, usually dark reddish brown, with very short, laterally paired idioblasts; testa brown, epidermal cells narrowly oblong, curved or straight, sometimes transversely thickened. Pappus bristles free to base and either deciduous as a whole or persistent but then sometimes breaking unevenly near base to produce a frayed margin, the cells at the area of the break being linear-acuminate and splinter-like. (Figure 1D, E, F)

10. Coronidium kaputaricum Paul G.Wilson, *sp. nov.*

Planta perennis decumbens, dense lanata. Folia in ramis conferta, omnino dense lanata, elliptica, acuta, versus basim attenuata, in toto 4–9 cm longa. Pedunculus terminalis, remote bracteatus. Capitulum solitarium, *c.* 3.5 cm diam. Bracteae involucrales albae, nitidae, dense confertae; lamina flaccida, anguste oblonga, acuminata, ad basim lanosa, ad 12 mm longa; unguis dense lanatus, anguste oblongus, crassus, cartilagineus. Cypsela *c.* 3 mm longa; pericarpium tenuiter crustaceum, opacum; pappi setae filiformes, plus minusve librae, persistentes.

Typus: New South Wales, Nandewar Range, Mt Kaputar National Park, The Governor, 13 November 1995, *I.R. Telford* 12080 (*holo*: PERTH 06072976; *iso*: CANB, K, MEL, NE, NSW, all *n.v.*).

Decumbent, densely woolly *perennial*. *Leaves* congested, densely woolly all over, elliptic, acute, narrowed to a petiole half the length of or equal to lamina, in all 4–9 cm long, dead leaves semipersistent. *Peduncle* terminal, densely woolly, to 10 cm long, remotely bracteate. *Capitulum* solitary, *c.* 3.5 cm diam., subtended by one or two woolly bracts. *Involucral bracts* white, glossy, congested, lamina weak, very narrowly oblong-acuminate, woolly towards base, to 12 mm long; claws densely woolly, very narrowly oblong, thick, cartilaginous, with a single nerve, the outer very short, the intermediate *c.* 4 mm long. *Style appendage* rounded. *Cypsela c.* 3 mm long; pericarp thinly crustaceous, fawn-coloured, opaque, with paired linear idioblasts 0.1–0.2 mm long; testa dark reddish brown. *Pappus* bristles filiform, minutely denticulate, barbellate at apex, smooth and broadened towards base, ± free, persistent.

Distribution and habitat. Known only from the Nandewar Range in the Northern Tablelands of New South Wales. Evidently confined to crevices in basaltic cliff faces.

Selected specimens examined. NEW SOUTH WALES: Mt Kaputar National Park, Dec. 1977, *J. Friend* (NSW); walking track near The Governor, *A.M. Lyne* 1300 *& J. Lyne* (CANB); Nandewar Range, The Governor, 25 Aug. 1973, *B. Muffet s.n.* (CANB).

Etymology. The specific epithet refers to the type locality.

Note. The relationship of this species to other members of the *C. elatum* group is unclear.

11. Coronidium boormanii (Maiden & Betche) Paul G.Wilson, *comb. nov.*

Helichrysum boormanii Maiden & Betche, *Proc. Linn. Soc. New South Wales* 30:366(1905). *Lecto* here chosen: Boonoo Boonoo, New South Wales, Nov. 1904, *J.L. Boorman* (*lecto*: NSW 230757; *isolecto*: MEL1585991), see *Notes*.

Illustration. Harden (1992) p. 233, as *Helichrysum boormanii*

Erect, *perennial herb* to 1.5 m high. *Branches* densely glandular-hirsute, sparsely cottony along lines decurrent from leaf-margins. *Leaves* viscid, elliptic to narrowly elliptic, to 10 cm long, acuminate to attenuate, cuneate and stem-clasping at base, entire, smooth, glandular-puberulous on both surfaces. *Capitula* on leafy peduncles, in corymbs or solitary, hemispherical, 3–6 cm diam.; *involucral bracts* very narrowly oblong, acuminate, white, claw slender, semi-terete, reddish brown, prominently glandular-hirsute, outer bracts clawed, loosely arranged and sometimes extending down peduncle. *Style apex* narrowly triangular. *Cypsela* obscurely 4-angled, *c.* 2.5 mm long; pericarp crustaceous, dark brown, glossy, with numerous short elliptic idioblasts *c.* 0.05 mm long. *Pappus bristles* free, persistent as a whole or breaking unevenly near base.

Distribution and habitat. Found in the Northern Tablelands of New South Wales in the hills north of Tenterfield where it predominantly grows over granite rock in open eucalypt forest.

Selected specimens examined. NEW SOUTH WALES: above Timbarra, east of Tenterfield, *J. Carrick* 3260 (AD); 8 m [*c.* 15 km] NE of Tenterfield, *I.R. Telford* 2498 (CANB); 9.9 km S of Boonoo Boonoo River on Mt Lindesay Hwy, *Peter G. Wilson* 1322 *& R. Rowe* (BRI).

Notes. The type citation for *Helichrysum boormanii* was as follows: 'Atherton, N. Queensland (E. Betche; Aug. '01); Boonoo Boonoo, N.S.W. (J.L. Boorman, Nov. '04)'. C.T. White, in a comment dated 7 March 1940, on the Betche syntype in BRI wrote 'M & B in their original account of the species listed 2 collections, Atherton *E. Betche* & Boonoo Boonoo *J.L. Boorman* though they distributed the latter as a type their description applies more especially to the Atherton plant & that's the one I would regard as the type of the species.' The name *H. boormanii* is here lectotypified on the Boorman collection since this action appears to have been the intention of Maiden and Betche and which also has the advantage of preserving the epithet *boormanii.*

The lectotype sheet has a label written and signed by Boorman, the collector, which is dated January 1903. In the protologue the collecting date is given as November 1904, which agrees with the printed label on the lectotype sheet and with the typed labels on the isolectotype sheets in MEL and NSW.

The cypsela of *C. boormanii, sensu lectotypica,* is of the '*elatum*' form, while the cypsela of the Betche syntype (which is here referred to *C. lanuginosum*) is of the '*oxylepis*' form.

12. **Coronidium elatum** (A.Cunn. ex DC.) Paul G.Wilson, *comb. nov.*

Helichrysum elatum A. Cunn. ex DC., *Prodr.* 6: 193 (1838); *Gnaphalium elatum* (DC.) Sch.Bip., *Bot. Zeitung (Berlin)* 3: 171 (1845) *nom. illeg. non* Lam. (1788). *Type*: 'in Nova-Hollandia orient. et merid.', ex herb. Museum de Paris (*syn*: G-DC microfiche photo seen); Illawara, *A. Cunningham* (*syn*: *n.v.*); Port Jackson, *A. Cunningham* 115 (*syn*: G-DC microfiche photo seen); *F. Sieber* 346 (*syn*: G-DC microfiche photo seen).

Helichrysum albicans Sieb. ex Spreng., *Syst. Veg.* 3: 482 (1826) *nom. illeg. non* A. Cunn. (1825); *Helichrysum albicans* Spreng. var. *commune* Domin, *Biblioth. Bot.* 89: 668 (1929) *nom. illeg.* ≡ *H. albicans Spreng.* var. *albicans*. *Type*: '*Novae Hollandia*', *F. Sieber* 346 (*iso*: G-DC microfiche photo seen).

Erect *subshrub* to 2 m high. *Branches* woolly. *Leaves* ovate to elliptic, acute, entire or slightly sinuate, to 12 cm long, chartaceous, pinnately veined, woolly below, glabrous or sparsely cottony above, petiole slender, 1–2 cm long, woolly. *Peduncles* slender, woolly, with few linear, herbaceous bracts. *Capitula* solitary, or in a compact or open cyme, 4–5 cm diam., hemispherical, subtended by linear-acuminate, woolly, herbaceous bracts; *involucral bracts* white to translucent; lamina of outer bracts ovate, subsessile; lamina of medial bracts narrowly oblong, acute to acuminate, claw slender, glandular-hirsute abaxially, cottony, in all to 20 mm long. *Style apex* ovate. *Cypsela* cylindrical, 2.0–2.5 mm long; pericarp crustaceous, opaque, dark reddish brown, smooth or pitted with few to numerous narrowly elliptic myxogenic idioblasts *c.* 0.05 mm long. *Pappus bristles* filiform, persistent as a whole or breaking *c.* 0.5 mm above persistent base to leave a frayed margin.

Distribution and habitat. Found in far eastern New South Wales, far eastern Victoria, and far south-eastern Queensland. It has been collected from eucalypt forests, often in mountainous situations.

Note. Tvrtković-Šahin (1982) noted the presence of scattered micropapillae on the epicarp, she also remarked on the prominent 'subreticulate pattern of secondary sculpturing' in the non-idioblastic cells.

Three subspecies are recognised.

1. Leaves elliptic, to 12 cm long, woolly below, capitula solitary or clustered
  2. Leaves and branches closely woolly; capitula in cymes .... **12a.** subsp. **elatum**
  2: Leaves and branches covered with thick wool; capitula solitary on long woolly peduncles .... **12b.** subsp. **vellerosum**
1: Leaves ovate (to elliptic), to 8 cm long, with thin dense tomentum below....................... **12c.** subsp. **minus**

12a. **Coronidium elatum** (A.Cunn. ex DC.) Paul G.Wilson subsp. **elatum**

Illustrations. Fairley & Moore (1989) p. 316, pl. 1155, as *Helichrysum elatum*; Harden (1992), pl. 13, as *Helichrysum elatum*; Walsh & Entwisle (1999) p. 786, Figure 156 e, as *Helichrysum elatum*

Erect *subshrub* to 2 m high. Branches woolly or floccose. *Leaves* narrowly elliptic to elliptic, acute, entire or slightly sinuate, lamina to 12 cm long, woolly below, glabrous or sparsely cottony above, petiole slender, 1–2 cm long, woolly. *Capitula* in a compact or open cyme; peduncles 1–5 cm long;

involucre hemispherical, *c.* 4 cm diam., subtended by linear-acuminate, woolly, herbaceous bracts. Median *involucral bracts* acuminate, to 20 mm long. *Cypsela* cylindrical, *c.* 2.5 mm long; pericarp crustaceous, dark brown, pitted with numerous narrowly elliptic myxogenic idioblasts *c.* 0.05 mm long. *Pappus bristles* filiform, persistent as a whole or breaking *c.* 0.5 mm above persistent base. (Figure 6)

Distribution and habitat. Occurs in coastal extreme south-east Queensland, far eastern and coastal New South Wales, and far south eastern Victoria. It is usually found growing in eucalypt forest, often in mountains.

Selection of specimens of examined. QUEENSLAND: Mt Lindesay, *S.L. Everest* 1124 (BRI); Fraser Island, *C.E. Hubbard* 4382 (BRI). NEW SOUTH WALES: near Maquarie Falls, *C.W.E. Moore* 3414 (CANB). VICTORIA: 11.8 km north-east of Mt Tabby, *S.J. Forbes* 193 (CANB); mouth of Betka River, 23 Oct. 1948, *J.H. Willis s.n.* (MEL).

12b. Coronidium elatum subsp. **vellerosum** Paul. G.Wilson, *subsp. nov.*

Subsp. *elato* aemulans sed ramis crasse lanosis vel floccosis; folii lamina elliptica, acuta, ad 9 cm longa, infra crassi-lanosa, supra sparse lanosa, petiolo gracili 1–2 cm longo; capitulis solitariis, 4–5 cm diam., in pedunculis gracilibus lanosis terminantibus differt.

Typus: Mt Warning, 14 km south-west of Murwillumbah, New South Wales, 19 August 1996, *I.R. Telford 12351 & S. Donaldson* (*holo*: CANB 9613491; *iso*: NSW *n.v.*, NE *n.v.*).

Differs from subsp. *elatum* as follows: erect subshrub to 1 m high. Branches thickly woolly or floccose. Leaves elliptic, acute, lamina to 9 cm long, with thick wool below, sparsely woolly above, petiole slender, 1–2 cm long, woolly. Capitula on slender woolly peduncles to 10 cm long; involucre hemispherical, 4–5 cm diam. (Figure 7)

Distribution and habitat. Endemic to Mt Warning, far north-east New South Wales, where it grows near the summit on rocky volcanic terrain.

Selected specimens examined. NEW SOUTH WALES: Mt Warning Park, *R. Coveny* 4313 *& J. Armstrong* (BRI); Mt Warning, Nov. 1898, *W. Forsyth* (NSW); Mt Warning, *R.W. Johnson* 2734 (BRI).

Etymology. The subspecific epithet refers to the dense wool that covers the undersurface of the leaves.

12c. Coronidium elatum subsp. **minus** Paul G.Wilson, *subsp. nov.*

Subsp. *elato* aemulans sed foliis lamina ovata vel elliptica, chartacea *c.* 5 cm longa, infra denso sed tenuiter tomentosa supra glabra vel sparse tomentosa, petiolo gracili *c.* 1 cm longo.

Typus: Point Lookout, New England National Park, N.S.W., 19 August 1969, *I.R. Telford* 1149 (*holo*: CANB 029740).

Subshrub to 30–80 cm high. *Branches* with thin dense tomentum. *Leaves* ovate to elliptic, lamina to 8 cm long with a slender petiole 1.5–2.5 cm long, chartaceous, with thin dense white tomentum

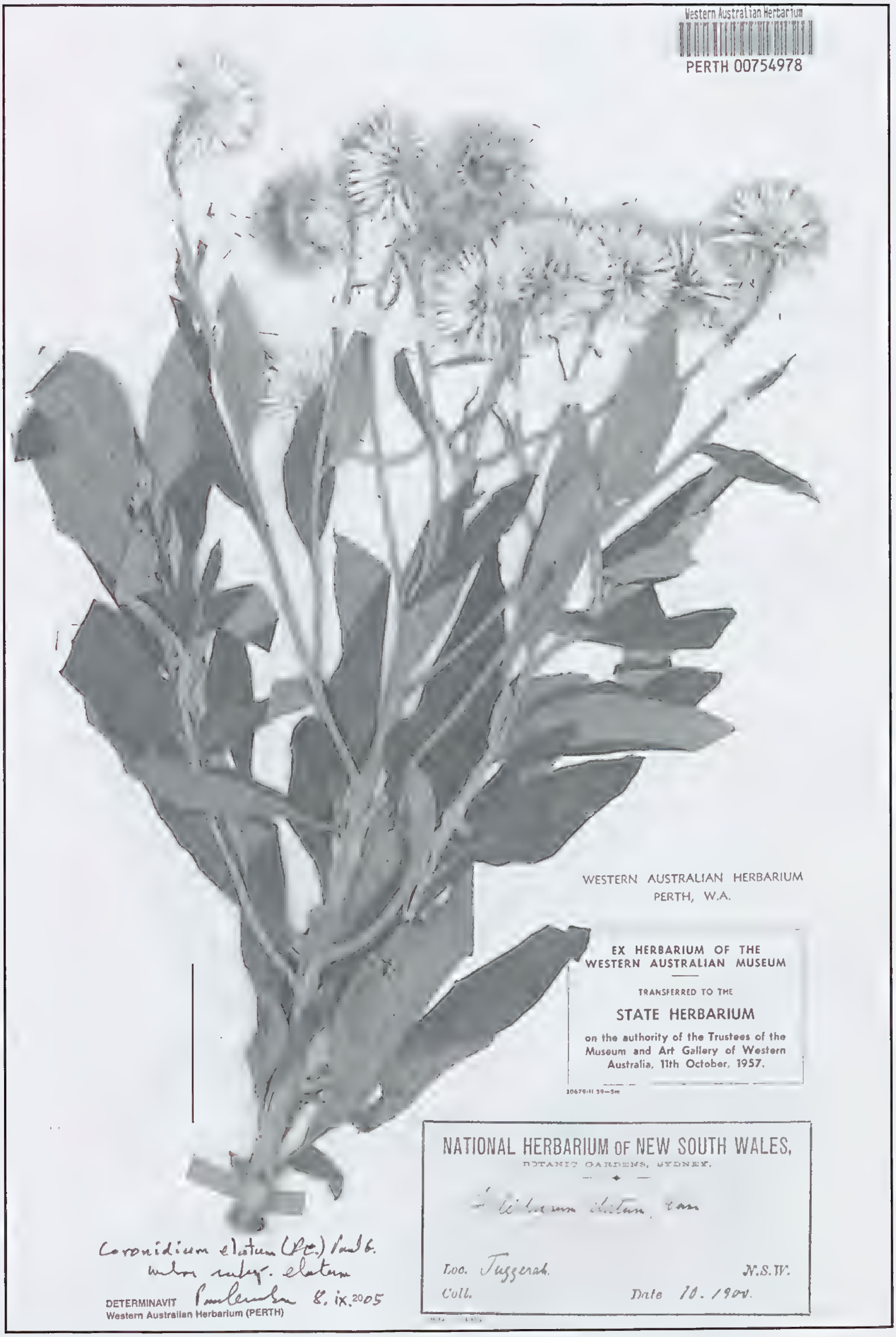
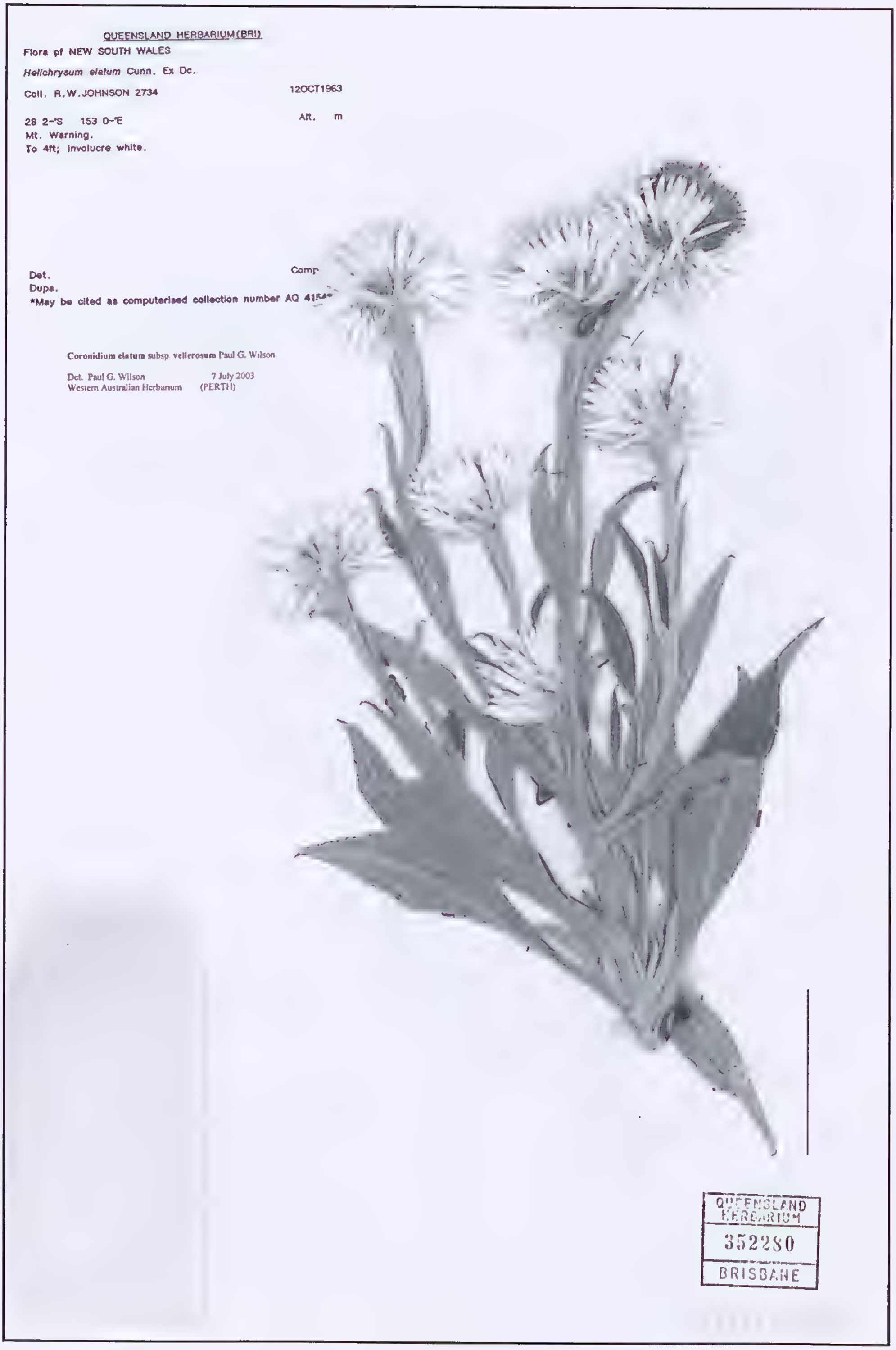

Western Australian Herbarium
PERTH 00754978
WESTERN AUSTRALIAN HERBARIUM
PERTH, W.A.
EX HERBARIUM OF THE
WESTERN AUSTRALIAN MUSEUM
TRANSFERRED TO THE
STATE HERBARIUM
on the authority of the Trustees of the Museum and Art Gallery of Western Australia, 11th October, 1957.
NATIONAL HERBARIUM OF NEW SOUTH WALES,
BOTANIC GARDENS, SYDNEY.
[illegible] elatum, [illegible]
Loc. Tuggerah. N.S.W.
Coll.
Date 10. 1900.
Coronidium elatum (DC.) Paul G. Wilson subsp. elatum
DETERMINAVIT 8. ix. 2005
Western Australian Herbarium (PERTH)

Figure 6. *Coronidium elatum* subsp. *elatum*. (*Anon.*, PERTH 00754978), scale = 5 cm.



QUEENSLAND HERBARIUM (BRI)
Flora of NEW SOUTH WALES
Helichrysum elatum Cunn. Ex Dc.
Coll. R.W.JOHNSON 2734 12OCT1963
28 2-'S 153 0-'E Alt. m
Mt. Warning.
To 4ft; involucre white.

Det. Comp
Dups.
*May be cited as computerised collection number AQ 41

Coronidium elatum subsp. vellerosum Paul G. Wilson

Det. Paul G. Wilson 7 July 2003
Western Australian Herbarium (PERTH)

QUEENSLAND HERBARIUM
352280
BRISBANE

Figure 7. *Coronidium elatum* subsp. *vellerosum* (*R.W. Johnson* 2734, AQ 415434), scale = 5 cm.

below, glabrous or sparsely woolly above. *Capitula* solitary or in open panicles; subtending herbaceous bracts linear- acuminate, densely woolly, the inner with scarious narrowly ovate appendage, grading into outer involucral bracts; *involucral bracts* narrowly oblong acuminate, pale white to translucent, the intermediate to 17 mm long. *Style apex* broadly ovate to rounded. *Cypsela* (not seen in mature state) reddish brown, *c.* 2 mm long; idioblasts present. *Pappus bristles* breaking *c.* 0.5 mm above persistent base. (Figure 8)

Distribution and habitat. Found in the Northern Tablelands of New South Wales in the New England National Park. The collecting data indicate that the plants were growing in clay loam over basalt in *Nothofagus moorei* forest.

Selected specimens examined. NEW SOUTH WALES: Beech Lookout, New England National Park, *D.L. Jones* 6027 *& C. Broers* (CANB); Point Lookout, Great Escarpment, New England National Park, *I.R. Telford* 10758 (AD, CANB).

Etymology. The subspecific epithet refers to the small size of the leaves compared to those found in subsp. *elatum.*

Notes. Subspecies *minus* has smaller leaves with a thinner and more dense indumentum than is found in subsp. *elatum*; it would appear, however, to grade into the latter subspecies which occurs on the same mountain range but at a lower altitude (*fide* I.R. Telford, pers. com.).

13. **Coronidium telfordii** Paul G.Wilson, *sp. nov.*

Coronidio elato aemulans sed fruticulo 25–80 cm alto, lamina foliorum ovata vel elliptica chartacea ± tri-nervosa, plerumque 3–5 cm longa, infra denso sed tenuiter tomentosa flavido-grisea, supra glabra, petiolo gracili *c.* 1 cm longo; capitulis solitariis; bracteis involucri anguste oblongis acutis, pallido albis vel translucentiis, intermediis ad 17 mm longis differt; cypselae laevibus, nitidis, idioblastis carentibus.

Typus: Mt Merino, McPherson Range, Qld, 30 September 1973, *I.R. Telford 3357* (*holo*: CANB 050131; *iso*: BRI, K *n.v.*, L *n.v.*, NE *n.v.*).

Helichrysum sp. 1., Stanley & Ross, *Fl. South-eastern Queensland* 2: 537 (1986).

Helichrysum sp. (Mt Merino S.T. Blake 21554), *Queensland vascular plants* p. 39 (1994).

Illustration. Nicholson & Nicholson (2004) p. 40 as *Helichrysum* sp. Mt Merino.

Subshrub 25–50(–80) cm high. *Branches* with thin, dense tomentum. *Leaves* ovate to elliptic, lamina 3–5 cm long with slender petiole to 1 cm, chartaceous, ± 3-nerved from near base with thin, dense tomentum below, glabrous above. *Capitula* solitary or in small open panicles, *c.* 3.5 cm diam.; subtending herbaceous bracts close to capitulum, linear, densely woolly, with scarious, narrowly acuminate appendage, grading into outer involucral bracts; *involucral bracts* narrowly oblong, acute, pale white to translucent, the intermediate to 17 mm long with glandular-stipitate claw. *Style apex* broadly ovate to rounded. *Cypsela* smooth, reddish brown, glossy, *c.* 1.2–2 mm long; *idioblasts* absent. *Pappus bristles* eventually breaking *c.* 0.6 mm above base leaving a frayed margin. (Figure 9)

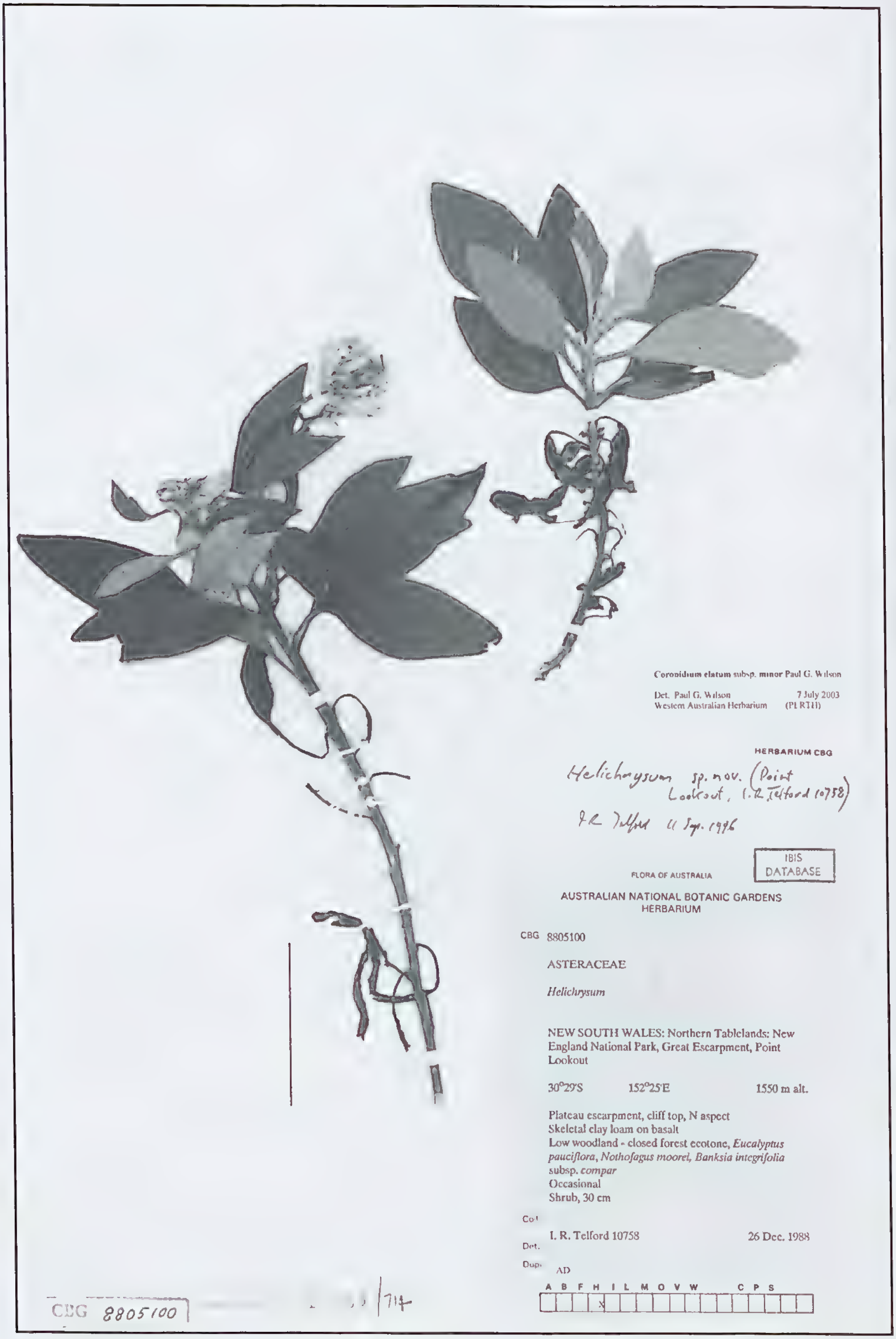

Coronidium elatum subsp. minor Paul G. Wilson
Det. Paul G. Wilson 7 July 2003
Western Australian Herbarium (PERTH)
HERBARIUM CBG
Helichrysum sp. nov. (Point Lookout, I.R. Telford 10758)
I.R. Telford 11 Sep. 1996
IBIS DATABASE
FLORA OF AUSTRALIA
AUSTRALIAN NATIONAL BOTANIC GARDENS HERBARIUM
CBG 8805100
ASTERACEAE
Helichrysum
NEW SOUTH WALES: Northern Tablelands: New England National Park, Great Escarpment, Point Lookout
30°29'S 152°25'E 1550 m alt.
Plateau escarpment, cliff top, N aspect
Skeletal clay loam on basalt
Low woodland - closed forest ecotone, Eucalyptus pauciflora, Nothofagus moorei, Banksia integrifolia subsp. compar
Occasional
Shrub, 30 cm
Col
I. R. Telford 10758 26 Dec. 1988
Det.
Dup. AD
A B F H I L M O V W C P S
CBG 8805100
714

Figure 8. *Coronidium elatum* subsp. *minus*. (*I.R. Telford* 10758, CBG 8805100), scale = 5 cm.

Distribution and habitat. Found near Mt Merino in the McPherson Range on the New South Wales–Queensland border. The collecting data generally indicate that the plants were growing on rocky ledges at the margin of *Nothofagus moorei* forests.

Selected specimens examined. QUEENSLAND: Mt Merino, McPherson Range, *S.T. Blake* 21554 (BRI); Roberts Plateau, Nov. 1921, *W.D. Francis s.n.* (BRI). NEW SOUTH WALES: Tyalgum Ridge, Macpherson Range, *L. Haegi* 1527 (NSW); near Echo Point, McPherson Range, *I.R. Telford* 10540 (CANB).

Etymology. The species is named after the botanist Ian Telford, formerly of the Australian National Botanic Gardens and the Australian National Herbarium, who drew my attention to the unique characters possessed by this species. Ian has collected extensively in eastern Australia over many years and has accumulated a wealth of knowledge on the plants of this area and, in this instance, on the *Coronidium* species.

14. Coronidium lindsayanum (Domin) Paul G.Wilson, *comb. nov.*

Helichrysum lindsayanum Domin, *Biblioth. Bot.* 89: 670 t. 38 figure 1 (1929). *Type*: 'Mt Lindsay', Queensland, 1829, *C. Fraser* (*lecto* here designated: K, photo seen); 'Mt Lindsay', 25 December 1857, *W. Hill* (*syn*: MEL, NSW).

Helichrysum elatum var. *fraseri* Benth., *Fl. Austral.* 3: 621 (1867) *p.p.* as to the *C. Fraser* and *W. Hill* syntypes. *Type*: 'Mt Lindsay', Queensland, 1829, *C. Fraser* (*lecto* here designated: K, photo seen); 'Mt Lindsay', Queensland, *W. Hill* (*syn*: MEL, NSW).

Illustrations. Leiper (2003) p. 165, back cover, as *Helichrysum lindsayanum*

Low, compact *shrub*. *Branches* densely woolly, older parts with persistent leaf-bases. *Leaves* crowded, shortly petiolate, leathery, narrowly elliptic to elliptic, usually recurved on margin, obtuse to acute, apiculate, narrowly cuneate at base, to 5 cm long, felty below, glabrous and glossy above. *Capitula* subsessile to shortly pedunculate, solitary, hemispherical, *c.* 4 cm diam., subtended by several linear, herbaceous bracts; *capitular bracts* white or pale pink, woolly at base, lamina very narrowly oblong-elliptic, outermost sessile or subsessile, intermediate with semi-terete, glandular-stipitate claws, in all to 20 mm long. *Style* appendage deltoid, *c.* 0.2 mm long. *Cypsela c.* 2.2 mm long; pericarp pale brown, crustaceous; idioblasts linear, obscure; carpophore tumid; testa membranous. *Pappus bristles* filiform, denticulate, persistent or breaking irregularly near base.

Distribution and habitat. Occurs in the McPherson Range, south-eastern Queensland and north-eastern New South Wales, where it is found growing in the crevices of rocky outcrops.

Selected specimens examined. QUEENSLAND: Campbells Folly, *S.L. Everist* 1141 (BRI); Mt Maroon, *L.S. Smith* 12148 (BRI); Mt Ernest, *C.T. White* 8604 (BRI). NEW SOUTH WALES: 'Mt Lindsay' [Mt Lindesay], 11 Nov. 1952, *E.F. Constable s.n.* (NSW).

Notes. The excluded syntype of var. *fraseri* is a collection made by MacGillivray at Port Curtis; it is also the type of *H. boormanii* var. *gillivrayi* Domin (= *C. lanuginosum*).

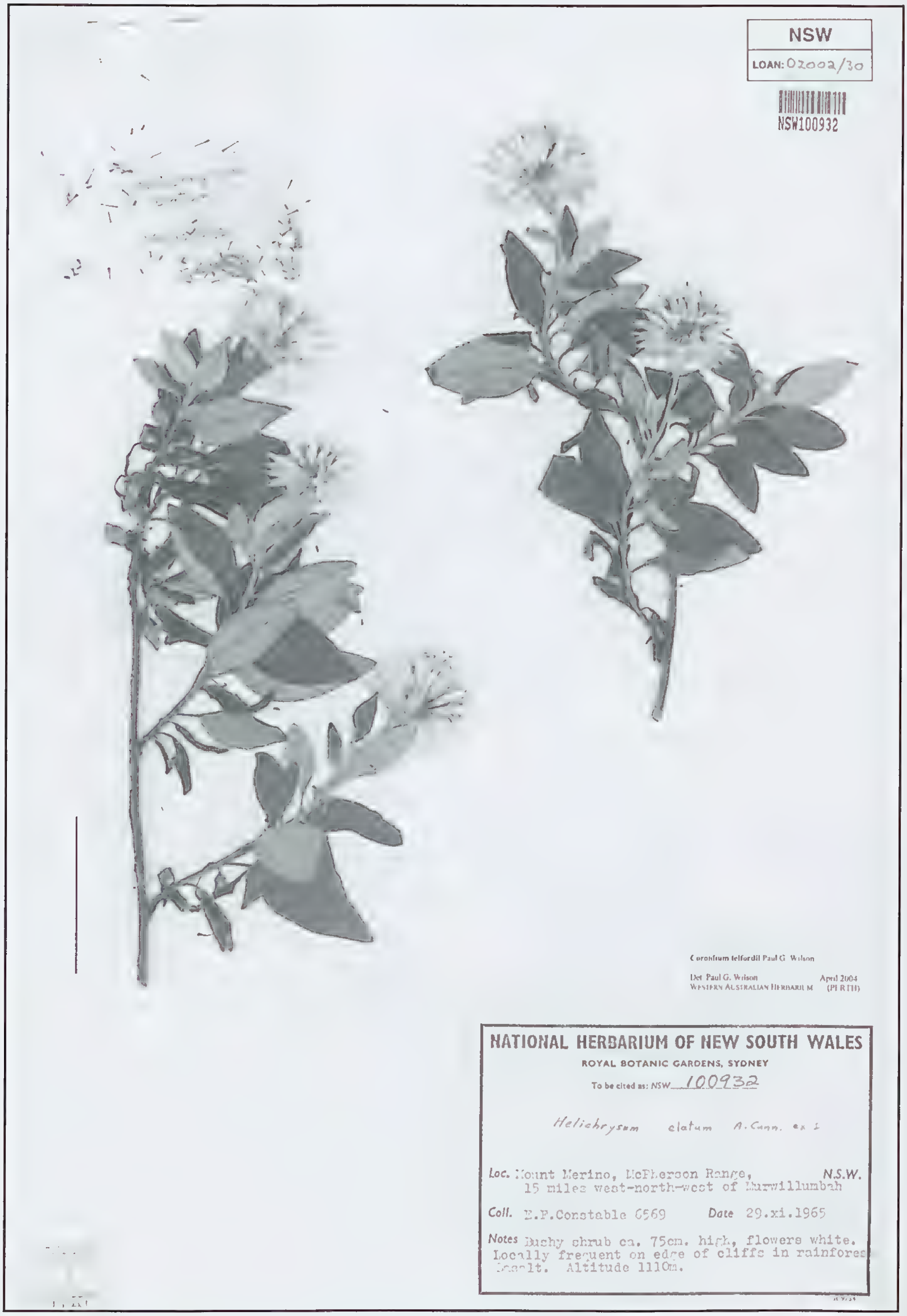

NSW
LOAN: 02002/30
NSW100932
Coronidium telfordii Paul G. Wilson
Det. Paul G. Wilson April 2004
WESTERN AUSTRALIAN HERBARIUM (PERTH)
NATIONAL HERBARIUM OF NEW SOUTH WALES
ROYAL BOTANIC GARDENS, SYDNEY
To be cited as: NSW 100932
Helichrysum elatum A. Cunn. ex
Loc. Mount Merino, McPherson Range, N.S.W.
15 miles west-north-west of Murwillumbah
Coll. E.F. Constable 6569 Date 29.xi.1965
Notes Bushy shrub ca. 75cm. high, flowers white.
Locally frequent on edge of cliffs in rainforest
basalt. Altitude 1110m.

Figure 9. *Coronidium telfordii* (*E.F. Constable* 6569, NSW 100932), scale = 5 cm.

The presumed isosyntypes of var. *fraseri* and of *Helichrysum lindsayanum* in the herbaria MEL and NSW, collected by W. Hill at 'Mt Lindsay', differ from the Fraser collection of this species in their foliage, the leaves being elliptic and flat rather than narrowly elliptic and strongly recurved. They also differ in these characters from Domin's description and illustration of *H. lindsayanum.* However, I am treating all of the syntypes as being conspecific.

The name 'Mt Lindsay' is probably a misspelling for Mt Lindesay; this, according to Telford (1990), is now correctly known as Mt Barney which is on the Queensland side of the McPherson Range. The lectotype of *C. lindsayanum*, that is the C. Fraser collection, matches recent collections from Mt Barney. The syntype collected by W. Hill matches a collection made by E. Constable in 1952 at 'Mt Lindsay', which is probably Mt Lindesay, on the New South Wales side of the McPherson Range (*fide* S. Jacobs, pers. com.).

15. Coronidium adenophorum (F.Muell.) Paul G.Wilson, *comb. nov.*

Helichrysum adenophorum F.Muell., *Trans. & Proc. Victorian Inst. Advancem. Sci.* 38 (1855). *Type*: Kangaroo Island, South Australia, March 1851, [?] *F. Mueller* (*holo*: MEL 2116948).

Illustrations. Jessop & Toelken (1986) p. 1529, Figure 694 A, as *Helichrysum adenophorum*; Walsh & Entwisle (1999) p. 786, Figure 156 c, as *H. adenophorum* var. *adenophorum.*

Erect, single-stemmed *annual or biennial* to 50 cm high. *Stem* glandular-hirsute. *Leaves* sessile, linear, to 6 cm long, glandular-hirsute and scabrous above, with sessile and stipitate-glandular hairs below, margins recurved, apex acuminate, base slightly auriculate. *Capitula* solitary, hemispherical, to 4.5 cm diam., closely subtended by several leafy linear bracts. *Involucral bracts* white (or pink in bud); outer bracts sessile; intermediate bracts narrowly oblong-elliptic, acute, passing into a short, semi-terete, sparsely cottony, glandular claw; innermost bracts shorter, obovate and prominently ciliate. *Style appendage* rounded. *Cypsela c.* 1.5 mm long, oblongoid; pericarp crustaceous, brown, idioblasts broadly elliptic *c.* 0.05 mm long, myxogenic. *Pappus bristles* filiform, denticulate, smooth towards base, persistent or tardily deciduous intact.

Distribution and habitat. Found on Kangaroo Island and in the Murray region of South Australia, and in western Victoria. Usually growing in heath or woodland where it readily regenerates from seed after fire.

Selected specimens examined. SOUTH AUSTRALIA: Mt Abrupt, Grampians, *A.C. Beauglehole* 30198 (MEL); 3 km S of Kingscote, Kangaroo Island, *T.R.N. Lothian* 804 (AD); 5 km W of Mt Shaugh Conservation Park, 27 May 1992, *S. Ronson* (AD). VICTORIA: south-west of Murrayville, 9 Dec. 1916, *H.B. Williamson* (MEL).

16. Coronidium waddelliae (J.H. Willis) Paul G.Wilson, *comb. nov.*

Helichrysum adenophorum F.Muell. var. *waddelliae* J.H.Willis, *Victorian Naturalist* 61: 217(1945) '*waddellae*'. *Type*: Mt Speculation, Victoria, 5000–5400 ft, 1 January 1945, *J.H. Willis* (*holo*: MEL 2116946; *iso*: MEL 658095, MEL 2116947, NSW 519019).

Illustration. Walsh & Entwisle (1999) p. 786, Figure 156 d, as *Helichrysum adenophorum* var. *waddelliae.*

Erect, multistemmed *perennial herb*. Stem glandular-hirsute. *Leaves* sessile, linear, to 5 cm long, sparsely glandular-puberulous above, glandular and white-woolly below, margins slightly recurved, apex acuminate. *Capitula* solitary, terminal to branches, hemispherical, to 4.5 cm diam., closely subtended by several linear, herbaceous bracts. *Involucral bracts* white (or pink in bud); *outer bracts* sessile; intermediate bracts narrowly oblong-elliptic, acute, passing into a semi-terete, sparsely cottony, glandular claw, innermost shorter, obovate and prominently ciliate. *Corolla* turbinate above. *Style appendage* rounded. *Cypsela c.* 2 mm long, oblongoid; pericarp crustaceous, pale brown, densely covered with broadly elliptic idioblasts *c.* 0.04 mm long, myxogenic. *Pappus bristles* filiform, denticulate, smooth towards base, persistent or tardily deciduous.

Distribution and habitat. Occurs in eastern Victoria and eastern New South Wales. It grows in alpine sites of snowgum woodland and heathland in Victoria and in alpine and subalpine sites in New South Wales.

Selected specimens examined. NEW SOUTH WALES: Kosciuszko National Park, *A.M. Ashby* 3149 (AD); 6 miles [*c.* 10 km] E of Kiandra, *N.T. Burbidge* 3804 (CANB); Newnes Plateau, *A.J. Whalen* 25 (AD). VICTORIA: Mt Buffalo National Park, 20 Feb. 1963, *J.H. Willis* (MEL).

Coronidium scorpioides group

Style appendage short, truncate. Cypsela: pericarp translucent; idioblasts laterally paired, clear, linear; testa fusiform, brown, epidermal cells linear, straight, not thickened; carpophore very short, apparently one cell thick. Pappus bristles narrowly linear to filiform, denticulate, smooth towards base, ± persistent, breaking irregularly a short distance above base to leave a frayed margin.

17. Coronidium scorpioides (Labill.) Paul G.Wilson, *comb. nov*

Helichrysum scorpioides Labill., *Nov. Holl. Pl. Sp.* 2: 45, t.191 (1806); *Gnaphalium scorpioides* (Labill.) Poir. in Lam. & Poir., *Encycl. Suppl.* 2: 808 (1812); *Xeranthemum scorpioides* (Labill.) Poir. in Lam. & Poir., *Encycl. Suppl*. 3: 143 (1813). *Type*: 'in capite Van-Diemen', Tasmania, *J.J.H. de Labillardiére* (*iso*: G-DC, microfiche photo seen).

Helichrysum buphthalmoides Sieber ex Spreng., *Syst. Veg*. 3: 484 (1826). *Type*: 'Nov. Holl.', [Near Port Jackson], New South Wales, *F. Sieber* 333, *fide* DC., *op. cit.* 194 (*iso*: G-DC, microfiche photo seen).

Helichrysum rutidolepis DC., *Prodr.* 6: 194 (1838); *Gnaphalium rutidolepis* (DC.) Sch.Bip., *Bot. Zeitung* 3: 171 (1845). *Type*: 'Grassy spots on the banks of Creek, near Port Jackson', New South Wales, April 1824, *A. Cunningham* (*holo*: G-DC, microfiche photo seen).

Helichrysum semipapposum var. *gunnianum* DC., *Prodr*. 6: 195 (1838). *Type*: Tasmania, *R. Gunn* 282, 262 (*syn*: G-DC microfiche photo seen).

Helichrysum gunnianum Hook., *Icon. Pl.* t. 320 (1840); *Gnaphalium gunnianum* (Hook.) Sch.Bip., *Bot. Zeitung* 3: 172(1845). *Type*: Tasmania, *R. Gunn* 502 (?*iso*: MEL, PERTH photo).

Helichrysum erosum Schltdl., *Linnaea* 20: 595 (1847). *Type*: South Australia, *H. Behr*, *n.v.*

Helichrysum scorpioides var. *pygmaea* F.Muell., *Monthly Notices, Pap. & Proc. Roy. Soc. Tasmania* for 1870: 14 (1871). *Type*: 'Alpine summit of Mt Wellington', Tasmania, *Abbott & F. Mueller, n.v.*

Illustrations. Walsh & Entwisle (1999) p. 786, Figure 156a, as *Helichrysum scorpioides*; Figure 156 b, as *H. Rutidolepis.*

Herb, usually rhizomatous. *Stems* erect, simple or sparsely branched. *Leaves* narrowly obovate to linear-acuminate, ± woolly, with minute globular glands below, decreasing in size upwards. *Capitula* solitary, depressed-hemispherical, woolly at base, not subtended by herbaceous bracts, 1.5–3 cm diam. *Involucral bracts* scarious, transversely wrinkled; outer bracts: claw narrow, flat, woolly-ciliate towards base; *lamina* narrowly obovate, straw-coloured tipped with brown; intermediate and inner bracts: claw semi-terete; lamina narrowly obovate, yellow; innermost bracts with a slender, semi-terete claw and a very narrowly obovate, sometimes lacerate lamina. Some outer florets female. *Corolla* of bisexual florets slender, broadly turbinate above, prominently lobed. *Anther appendage* narrowly ovate. Style arms slender, appendage short, truncate or rounded. *Cypsela:* pericarp translucent with paired, clear, linear idioblasts; testa fusiform, brown, epidermal cells linear, straight, not transversely thickened; carpophore very short. *Pappus bristles* filiform, sparingly denticulate, smooth towards base, ± persistent or breaking above base to leave a fringed crown. n = 24 (Watanabe *et al* 1999: 785).

Distribution and habitat. Occurs in south-eastern South Australia, Victoria, eastern New South Wales, and Tasmania; frequently found in open woodland but also growing in many other habitats.

Selected specimens examined. SOUTH AUSTRALIA: Emu Flat, Ninety Mile Desert, *W. Gill* 230 (MEL). NEW SOUTH WALES: Tinderry Mountains, *G. Stewart* 300 (PERTH). VICTORIA: Brodribb Forest, Bonang District, *E.A. Chesterfield* 696 (PERTH). TASMANIA: 7 km NE of Huonville, *F.E. Davies* 796 (PERTH).

Notes. Haegi (1986) described *H. scorpioides* as being tap-rooted and as having only bisexual florets, while he described *H. rutidolepis* as being rhizomatous and as having female peripheral florets that had only a rudimentary pappus or the pappus completely lacking. In Costin *et al*. (2000) *H. scorpioides* is described as having branched rhizomes. Those herbarium specimens examined by me in which the subterranean parts were apparent have been rhizomatous, while all mature capitula examined had some of the outer florets female and these all had a pappus. Curtis (1963) described *H. scorpioides* as having a long slender rhizome in Tasmania, and in Labillardière's description of the type specimen, which came from the south coast of Tasmania, he noted that the outer florets were female and these he illustrated as having a pappus.

Reports on the study of *C. scorpioides s. lat.* from various localities were published by Salkin (1990, 1998) and by Barker (2004); the conclusions reached by these investigators were that a number of taxa are involved. Although it seems probable that several taxa should be recognised I consider that their discrimination would be best carried out by someone with field knowledge of the plants.

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Notes on the genus *Chrysocephalum* (Angianthinae: Asteraceae) with the description of one new species from Western Australia, and a new combination

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Abstract

Wilson, P.G. Notes on the genus *Chrysocephalum* Walp. (Angianthinae: Asteraceae) with the description of one new species from Western Australia, and a new combination. *Nuytsia* 18: 331–338 (2008). The probability of the genus *Chrysocephalum* being paraphyletic is reviewed. *Helichrysum gilesii* F.Muell. is transferred to *Chrysocephalum*. A new species from the Gibson Desert, Western Australia is described and is compared with its close relative *C. gilesii* (F.Muell.) Paul G.Wilson. A widespread taxon from southern Australia which has been variously referred to as *Chrysocephalum apiculatum* (Labill.) Steetz or *C. aff. apiculatum* is shown to be *C. vitellinum* Sond.; this name is lectotypified. A key to the species of *Chrysocephalum* found in Western Australia is provided.

Introduction.

The acceptance by Anderberg (1991) of the genus *Chrysocephalum* Walp. as an Australian endemic taxon clearly distinct from *Helichrysum* Mill. was welcomed by the Australian taxonomic community and widely accepted in the horticultural industry. Anderberg's monograph should be consulted for a review of the data that supported that decision. This paper is concerned with a few of the points that have arisen during the preparation of a treatment of the genus for *Flora of Australia*.

Chromosome numbers

As was pointed out by Anderberg (1991), *Chrysocephalum* (Walpers 1841) is a genus not easily circumscribed if the species currently placed in *Leptorhynchos* Less. (Lessing 1832) and *Rutidosis* DC. (Candolle 1838) are excluded. The chromosome numbers for three of the four species referred to *Chrysocephalum* by Watanabe *et al.* (1999) have a base number of 12, while the fourth count applies to a species now transferred to *Leiocarpa* (Wilson 2001). Watanabe *et al.* (1999) also examined four species of *Leptorhynchos* each of which had a count of n = 12.

Of interest is a count made by Turner (1970) of '*Helichrysum* sp.' as *n*=10, the voucher of which is *Chrysocephalum vitellinum* Sond. (see below). If this count is correct it indicates that species in the genus *Chrysocephalum* have a chromosome number of n = 10 or 12.

These chromosome counts support the suggestion made by Anderberg (1991) that *Chrysocephalum* and *Leptorhynchos* should be considered congeneric in which case the latter generic name has priority since it was published earlier. However, until this matter can be thoroughly examined I am adopting the traditional generic circumscriptions and have therefore referred the species under consideration to *Chrysocephalum*.

Description

Chrysocephalum gilesii (F.Muell.) Paul G.Wilson, *comb. nov.*

Helichrysum gilesii F.Muell., *Fragm.* 10: 85 (1876).

Type: between the rivers Ashburton and Gascoyne, Western Australia, *E. Giles*. 'Inter fluvios Ashburton's et Gascoyne's River; E. Giles'(*holo*: MEL).

Principal distinguishing characters:

Inner involucral bracts with a thinly coriaceous narrowly oblong claw, sparsely pilose on margin and abaxial surface with hairs that have a stipe of 2–3 transversely placed cells and a narrowly ellipsoid (glandular?) apex of two parallel cells. The lamina is narrowly elliptic, acuminate, sparsely and shortly appressed pilose near the apex but otherwise glabrous except for the margin which is ciliate with simple slender acuminate hairs *c.* 0.5 mm long.

Multi-stemmed, tap-rooted *perennial herb*, to 50 cm high. *Stems* slender, branched, sparsely to moderately woolly, becoming glabrous towards apex. *Leaves* sessile, linear to narrowly elliptic, acuminate, to 6 cm long, thinly coriaceous, glabrous or sparsely woolly. *Capitula* solitary, terminal to branches, broadly turbinate or hemispherical, to 10 mm high; involucral bracts with narrowly oblong herbaceous claw papillose abaxially, and transparent, glossy, ciliate lamina, glabrous or minutely papillose towards apex, occasionally sparsely woolly on margin towards base. *Outer involucral bracts* very narrowly elliptic passing downwards into sessile peduncular bracts. *Medial involucral bracts*: claw narrowly oblong, 1–1.5 mm long, margin and adaxial surface with short stipitate glandular (?) hairs *c.* 0.05 mm long of which the swollen ellipsoidal apex is longitudinally divided into two cells while the short stipe is transversely divided into 2 or 3cells; lamina narrowly ovate, acuminate, transparent, ciliate, otherwise glabrous or minutely scabrous abaxially towards apex; lamina of innermost involucral bracts similar but narrower. *Florets* numerous, all bisexual; corolla shortly exceeding involucre, pale yellow. *Cypsela* narrowly cylindrical, *c.* 1.5 mm long, scabrous with globular myxogenic twin-hairs. *Pappus bristles c.* 10, capillary, barbellate, becoming very shortly plumose towards apex, persistent. (Figure 1 E–J)

Distribution. Widespread in the western-central and north-west regions of Western Australia, where found in the Little Sandy Desert, Pilbara, Gascoyne and Murchison IBRA Bioregions (Department of the Environment, Water, Heritage and the Arts 2008).

A recent collection from the Gibson Desert, Western Australia, brought attention to the presence of a distinct species that had been confused with *Chrysocephalum gilesii*. This is described below

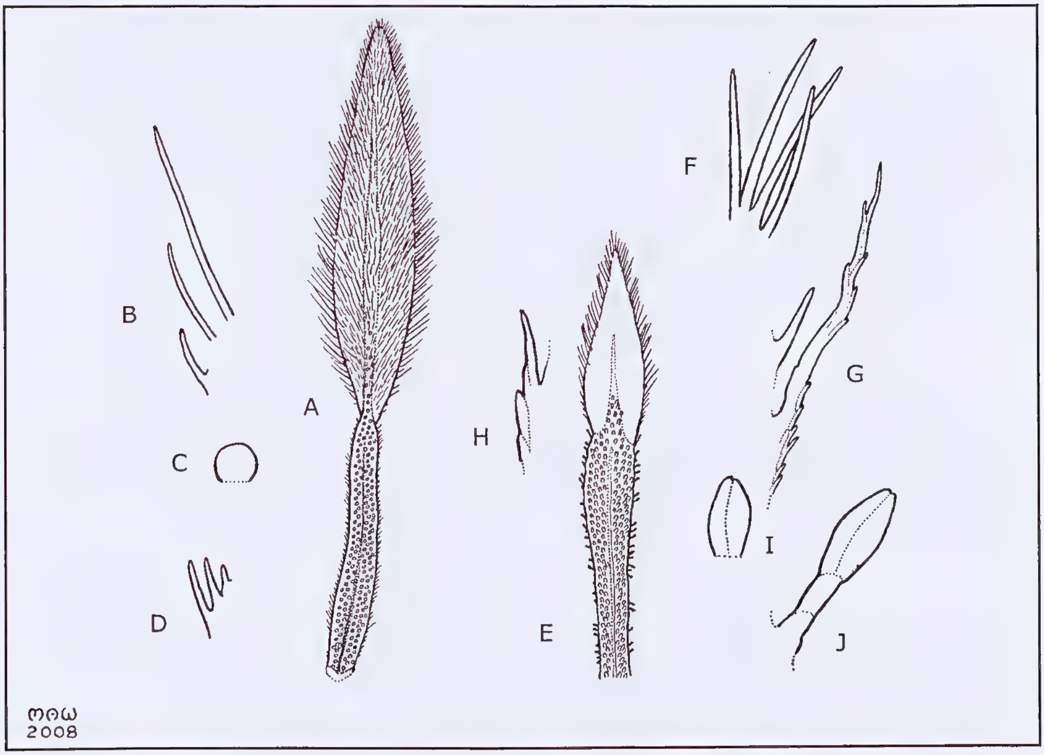

Figure 1. A – D. *Chrysocephalum sericeum*. A – innermost involucral bract, abaxial surface (× 11), B – marginal cilia on lamina (× 25), C – glandular hair on abaxial surface of claw (× 25), D – marginal cilia on claw (× 25); E – J. *Chrysocephalum gilesii*. E – innermost involucral bract, abaxial surface (× 11), F – marginal cilia on lamina (× 25), G – marginal cilia at junction of lamina and claw (× 25), H – marginal cilia near base of lamina (× 25), I – glandular hair on abaxial surface of claw, J – glandular hair on margin of claw (× 25). A – D drawn from *D.J. Pearson* 4015 (PERTH) and F – J drawn from *M.E. Trudgen* 15790 (PERTH).

Chrysocephalum sericeum Paul G.Wilson, *sp. nov.*

Chrysocephalo gilesii primo adspectu maxime simile sed ungue bracteis involucralibus interioribus ad marginem breviter ciliatis pilis uni-cellularibus *c.* 0.03 mm longis, pagina abaxiali glandibus globosis ornatis; lamina elliptica, acuminata, in superficiebus ambabus dense sericea, ad marginem ciliatis pilis gracilibus acuminatis ad 0.6 mm longis.

Typus: Western Australia, Gibson Desert Nature Reserve, 24° 28' 00" S, 124° 52' 00" E, 10 May 1994, *A.R. Annels* 21A (*holo*: PERTH 04607465).

Erect multi-stemmed *perennial herb* to 40 cm high with a slender tap-root. *Stems* slender, with ascending branches that are cottony towards the apex otherwise glabrous. *Leaves* alternate, narrowly oblong and 50 × 4 mm or linear to 50 × 1 mm, acuminate, recurved on margin (at least in dried state), sparsely gland dotted, sparsely cottony when young, with a few minute globular hairs on abaxial surface otherwise glabrous. *Upper leaves* shorter and with scarious apices, grading into the outer involucral bracts. *Capitula* terminal, solitary, hemispherical, *c.* 10 mm high, homogamous, disciform; involucral bracts with glossy transparent very pale golden scarious ciliate laminae. *Outer involucral bracts*: base fleshy, lamina scarious, linear, acuminate, sparsely ciliate. *Medial involucral bracts*: claw narrowly oblong to 3.5 mm long, 0.5 mm wide, coriaceous, with globular glands on abaxial surface; lamina narrowly ovate to ovate, acuminate, to 7 mm long, moderately ciliate (cilia slender, acuminate, 0.3–1 mm long), sparsely appressed-pubescent near tip otherwise glabrous. *Innermost involucral bracts*: claw *c*. 4 mm long, shortly ciliate on the margin with firm acuminate single-celled hairs *c*. 0.03 mm long, abaxial surface covered with globular glands; *lamina* acuminate-elliptic densely sericeous on abaxial and adaxial surfaces with simple slender hairs and on the margin moderately ciliate with simple slender acuminate hairs to 0.6 mm long that grade at the base to the short hairs on the claw. *Florets* bisexual, all fertile; corolla pale yellow, tubular, *c*. 7 mm long, shortly 5-lobed, glabrous; anther appendices narrowly oblong, obtuse; stigmas sub-globular. *Cypsela* terete, *c*. 1.7 mm long, 0.8 mm diam., densely covered with globose myxogenic twin-hairs (not seen in fully mature state); *pericarp* thick, translucent; testa brown. *Pappus bristles c*. 15, equal to corolla, white, capillary, free, barbellate, but setae longer and acuminate at apex. (Figure 1 A–D)

Other specimens examined. WESTERN AUSTRALIA: Gibson Desert: Gary Hwy between Gunbarrel Hwy and Windy Corner, 24 July 1967, *J.S. Beard* 4851 (PERTH); Gibson Desert Nature Reserve, 14 May 2000, *T.B. Bragg* 2 (PERTH); *ibid*., 15 May 2000, *T.B. Bragg* 37 (PERTH); Eagle Bore Study Site, 25 July 2002, *T.B. Bragg* 2001-73 (PERTH); Patience Well, 4 Feb. 2001, *C.P. Campbell* 149 (PERTH); Gibson Desert Nature Reserve, 3 Sep. 1994, *N. Burrows* SM3 (PERTH); *ibid*., 17 Oct. 1997, *N. Burrows* JK 9 (PERTH); 12 km W of Young Range, Sep. 1992, *Desert Dreaming Expedition* 54 (PERTH); 32 km S of Windy Corner, Gary Hwy, 20 July 2001, *P.K. Latz* 17876 (PERTH); Plot 3, Spinifex Track, 6 Sep. 1998, *G.L. Liddelow* 37 (PERTH); Gibson Desert: 5 km E of Gary Hwy, 2 July 1984, *G.J. Morse* 226 (CANB, PERTH); 9 km SW of Young Range, 26 Apr. 1994, *D.J. Pearson* 4015 (PERTH); Clutterbuck Hills Aboriginal Reserve, Gibson Desert, *W.A. Thompson* 245 & *J. Fogarty* (PERTH).

Distribution. Only recorded from the western portion of the Gibson Desert IBRA Bioregion.

Habitat. Hummock (*Triodia*) grassland with associated *Acacia* shrubs. Red sandy clay loam over laterite and sandstone.

Phenology. This species appears to flower and fruit throughout the year, presumably in response to rainfall.

Conservation status. Evidently widespread in the western half of the Gibson Desert and not under threat.

Etymology. The epithet refers to the silky indumentum on the lamina of the innermost 2–3 rows of bracts.

Affinities. The affinities of this species are obviously with *Chrysocephalum gilesii*, a species with similar habit and inflorescence but generally with a more prominent white cottony indumentum on the lower portions of the stems and with almost glabrous laminae to the inner involucral bracts which also have a different type of glandular hairs on their abaxial surface. The two species are disjunct in their distributions, *C. gilesii* being found in inland regions of the Keartland, Fortescue, Ashburton and Austin Botanical Districts with its most easterly occurrence about 300 km west of the most easterly record for *C. sericeum*.

Photographs of *Chrysocephalum sericeum*, taken by C.P. Campbell, appear in the Western Australian Herbarium *FloraBase*.

This species was brought to my attention by Wendy Thompson, Conservation Officer with the Department of Environment and Conservation, who collected it in the Gibson Desert.

Six species of *Chrysocephalum* are currently recognised as occurring in Western Australia and these may be identified with the following key.

Key to species of *Chrysocephalum* found in Western Australia

1. Capitula solitary at ends of slender branches
  2. Branches densely white tomentose; leaves erect or somewhat spreading
    3. Leaves appressed to branch; capitula turbinate; involucral bracts minutely scabrous on outer (abaxial) surface .... **C. puteale**
    3: Leaves appressed or slightly spreading; capitula hemispherical; involucral bracts smooth on outer (abaxial) surface .... **C. eremaeum**
  2: Branches glabrous or very sparsely woolly; leaves spreading
    4. Lamina of involucral bracts glabrous (or slightly pubescent at base) .... **C. gilesii**
    4: Lamina of innermost rows of involucral bracts sericeous on both surfaces .... **C. sericeum**
1: Capitula clustered at ends of branches
  5. Capitula turbinate; involucral bracts scabrous on outer (abaxial) surface .... **C. pterochaetum**
  5: Capitula hemispherical; involucral bracts smooth on outer (abaxial) surface .... **C. apiculatum**

Note. The name *Chrysocephalum apiculatum* (Labill.) Steetz is here used in the broad sense so as to encompass several taxa that have still to be definitively circumscribed.

During an examination of material of *Chrysocephalum apiculatum* from several Australian herbaria one variant from southern and south-eastern Australia stood out as specifically distinct, a fact also noted by several collectors, in particular R.J. Bates. This taxon was also recognised as a distinct species by J.A. Jeanes in the *Flora of Victoria* 4: 794 (1999) where it was referred to as '*Chrysocephalum* sp. 2'. The type material of *Chrysocephalum vitellinum* Sond. & F.Muell. ex Sond. (1853) on loan from MEL was found to be a precise match with this taxon.

Chrysocephalum vitellinum Sond. & F.Muell ex Sond., *Linnaea* 25: 514 (1853)

Type: 'Ultra Saltcreek, Novemb. Dr. Behr. In planitie circa urbem Adelaide. Nov. Lofty-ranges'. *Lectotype* here designated: Adelaide, Dr Ferdn Mueller, ex Herb. Sonder, lower specimen (MEL 2218946), see note.

Chrysocephalum sp. 2, J.A. Jeanes in N.G. Walsh & T.J. Entwisle, *Fl. Victoria* 4: 794 figure 158c (1999).

Plant annual, erect, single- or multi-stemmed, 2–25 cm high; stems slender, entire or branched, cottony. *Leaves* flaccid (?), oblong to narrowly obovate, to 3 cm long, obtuse, flat, prominently apiculate, shortly decurrent and slightly stem-clasping, cottony, shortly glandular-stipitate. *Capitula* congested in shortly pedunculate clusters forming a simple or branched inflorescence. *Involucre* cup-shaped, *c*. 5 mm diameter, woolly around base; *bracts* orange-yellow or the outer greyish. *Outer involucral bracts* shortly stipitate, narrowly ovate acuminate; *medial bracts*: stipe slender, terete, *c*. 1.2 mm long, glandular, lamina narrowly oblong, *c.* 2 mm long, long-ciliate becoming shortly so towards the dentate, acute to acuminate apex. *Inner involucral bracts*: lamina narrowly oblong with obtuse often undulate or wrinkled ciliate apex; surfaces with sparse trichomes on each face that resemble the cilia, mid-vein prominent. Innermost involucral bracts with narrowly oblong to linear stipe *c.* 2.5 mm long with prominent scarious margins, grading into the narrowly oblong, acuminate, ciliate lamina, *c.* 1.5 mm long. *Corollas* bending outwards. *Outer florets* female, fertile. *Bisexual florets* numerous. *Pappus bristles* filamentous, shortly plumose towards apex, in female floret solitary and positioned on adaxial margin, in bisexual florets 3–4, appearing as though attached sub-apically to achene. *Achene* narrowly ellipsoidal, 0.8 mm long, acute, scabrous. (Figure 2)

Selected specimens examined. New South Wales: 'Curraweena', N of Cobar, *E. D'Arnay & K. Wells* 657 (CANB); Yathong NR via Mt Hope, *Slee & Holgate* 284 (CANB). Victoria: 30.6 km SE of Walpeup on road to Patchewallock, *M.G. Corrick* 6697 (CANB); State Forest 21.5 km west of Teddywaddy, *N.C. Scarlett* NS80-168 (AD). South Australia: Wundersitz Scrub, Hartley, *R. Bates* 203942; Chowilla floodplain, Wentworth road, *C. O'Malley* 078 (AD); road to Karoonda, *c.* 15 km from Murray Bridge, *D.J.E. Whibley* 9916 (AD).

Distribution. Western Victoria, western New South Wales, south-central and eastern South Australia.

Habitat. Growing in grasslands, herb fields, and open eucalypt forest.

Chromosome number. Turner (1970) published the chromosome number for a taxon he referred to '*Helichrysum* sp.' as n = 10. The voucher collection of this taxon from Tailem Bend, South Australia (*B.L. Turner* 5596 MEL), is *Chrysocephalum vitellinum* (see comment on chromosome numbers above).

Note on lectotypification. There are three sheets in herb. MEL that have been segregated as being possible types of this name; each bears a specimen of *C. vitellinum* while two also have a specimen of *C. apiculatum s.l.*:

Sheet 1: 'Helichrysum vitellinum F. Muell.'; in pencil on same label: 'hoc veris. [verisimiliter?] H. flavissimum videtur! sive Chr. Ciliatum' Ex herb. J. Steetz (MEL 2217440).

This sheet contains one specimen which is of *Chrysocephalum vitellinum*.

Sheet 2: 'Helichrysum vitellinum Ferd. Muell. In planitiebus ante Lofty – range Octobr. Chrysocephalum flavissimum J.Hook. var.' [In Mueller's handwriting.] (MEL 2196377).

This sheet contains two specimens of which the upper one is *C. apiculatum* and the lower *C. vitellinum*. There is no indication that the specimens were seen by Sonder.

Sheet 3: 'Chrysocephalum vitellinum S. & M. / Adelaide / Dr Ferdn Mueller'. Ex herb. O.W. Sonder (MEL 2218946).

This is the only sheet that came from the Sonder herbarium and is the only one that bears on it a slip with the botanical name used by Sonder. The sheet contains two specimens of which the upper is *C. apiculatum* and the lower *C. vitellinum*.

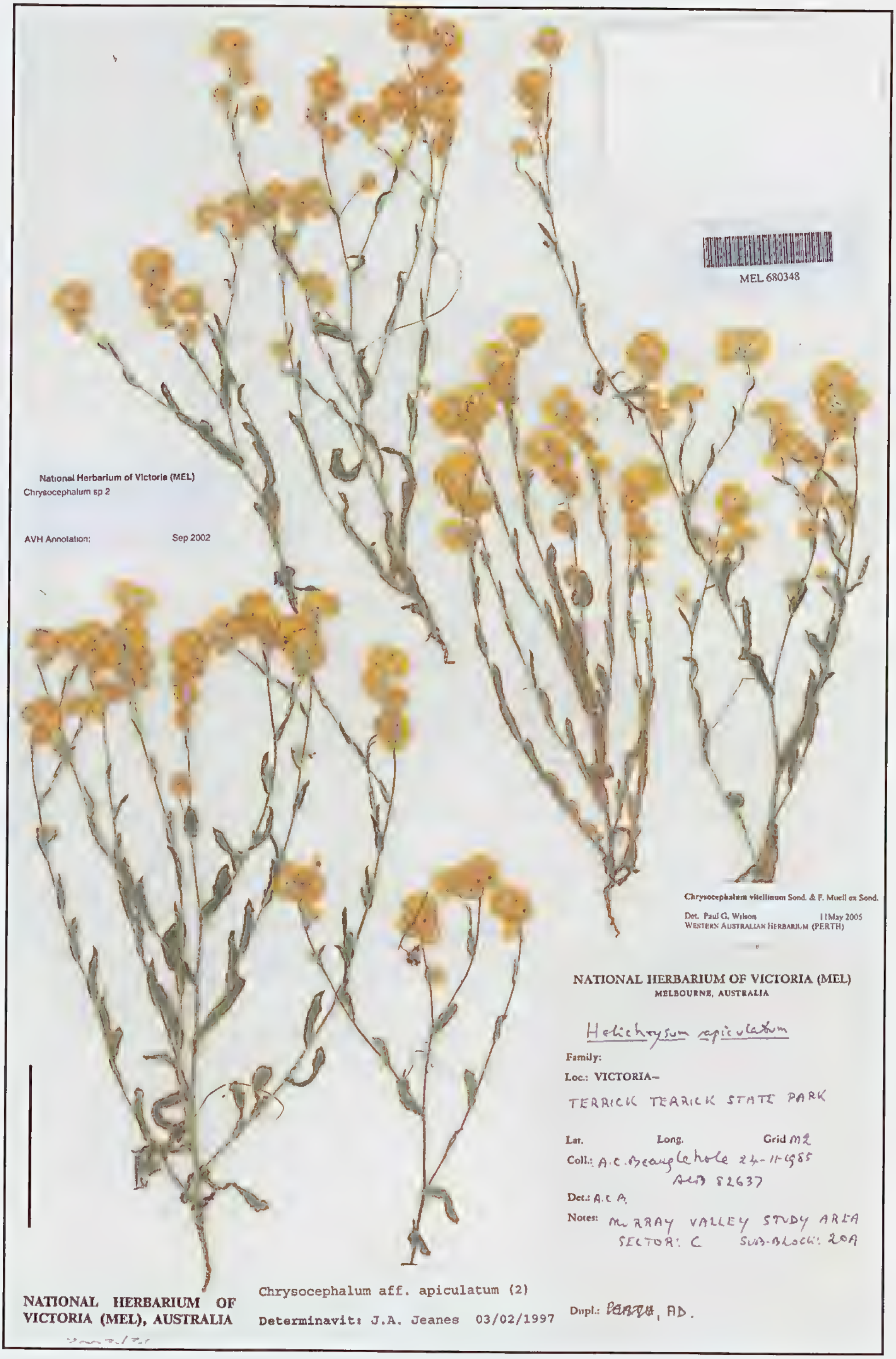
MEL 680348
National Herbarium of Victoria (MEL)
Chrysocephalum sp 2
AVH Annotation: Sep 2002
Chrysocephalum vitellinum Sond. & F. Muell ex Sond.
Det. Paul G. Wilson 11May 2005
WESTERN AUSTRALIAN HERBARIUM (PERTH)
NATIONAL HERBARIUM OF VICTORIA (MEL)
MELBOURNE, AUSTRALIA
Helichrysum apiculatum
Family:
Loc.: VICTORIA–
TERRICK TERRICK STATE PARK
Lat. Long. Grid M2
Coll.: A.C. Beauglehole 24-11-1985
ACB 82637
Det.: A.C.B.
Notes: MURRAY VALLEY STUDY AREA
SECTOR: C SUB-BLOCK: 20A
Dupl.: PERTH, AD.
NATIONAL HERBARIUM OF VICTORIA (MEL), AUSTRALIA
Chrysocephalum aff. apiculatum (2)
Determinavit: J.A. Jeanes 03/02/1997

Figure 2. *Chrysocephalum vitellinum*. Photograph of collection *A.C. Beauglehole* 82637 (MEL 680348), scale = 5 cm.

The lower specimen on Sheet 3 is here selected as lectotype. The specimen on Sheet 1 and the lower specimen on Sheet 2 may be syntypes or isosyntypes. I have not seen any collection of this species made by Behr near 'Saltcreek'.

This plant is sometimes associated on herbarium sheets with another member of the *C. apiculatum* group and in this case the extraneous material sometimes has a somewhat similar appearance, which suggests that it is of hybrid origin. If this is the case it could indicate that the recorded chromosome count for *C. vitellinum* is incorrect.

Acknowledgements

I am grateful to Margaret Wilson for illustrating the involucral bracts of *Chrysocephalum gilesii* and *C. sericeum*. The loan of specimens from the Australian herbaria AD, MEL and NSW was essential for the preparation of this paper. Some of the study was undertaken while the author was in receipt of a grant from the Australian Biological Resources Study. I am grateful to the referee for comments on an earlier manuscript.

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SHORT COMMUNICATIONS

Lepidosperma amansiferrum is an orthographic error of *L. amantiferrum*

The name *Lepidosperma amansiferrum* R.L.Barrett was recently published for a new species restricted to banded ironstone formations in the southern Goldfields of Western Australia (Barrett 2007). Karen Wilson and Peter Wilson (both Royal Botanic Gardens Sydney) recently drew my attention to an error in the way the Latin words were combined to form this name. Constructed from the Latin words *amans* (loving) and *ferrum* (iron), the word *amans*, when combined with *ferrum*, should be declined to *amanti-* (Stearn 1992). This is considered a correctable error under the current International Code of Botanical Nomenclature (McNeil *et al.* 2006; see Article 60.8 and Recommendation 60G), thus the correct name should be cited as follows: *Lepidosperma amantiferrum* R.L.Barrett, *Nuytsia* 17: 39–40 (2007) (as '*amansiferrum*').

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Kennedia lateritia, a new name for *Kennedia macrophylla* (Fabaceae)

The plant currently referred to as *Kennedia macrophylla* (Meisn.) Benth. is a twining or scrambling shrub with a very restricted distribution in the far south-west of Western Australia. It is listed as Declared Rare Flora under the *Western Australian Wildlife Conservation Act 1950* and is Endangered under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (DEWHA 2007). In contrast to its rarity in nature, this taxon is widely cultivated in temperate Australia (Jones & Gray 1977; Elliot & Jones 1993). In view of the horticultural and conservation significance of this species, a necessary change to its nomenclature is presented here in advance of a revision of the subtribe Kennediinae currently in preparation by the first author.

The first name applicable to this taxon is *Physolobium macrophyllum*, published by Meisner in 1848. In February 1864, Mueller described *Kennedia* [as '*Kennedya'*] *lateritia* in his *Fragmenta*, and in that work compared his new taxon to '*Kennedya macrophylla* (*Physolobium macrophyllum*, Meisn. in Lehm. *Plant. Preiss.* ii. 222)…' Mueller thereby created the combination *K. macrophylla* (Meisn.) F.Muell.; this is illegitimate since it is a later homonym of *K. macrophylla* Lindl. (1836), a different species (see below). Bentham (1864) also independently published this combination later in the same year as Mueller.

Type material of *Physolobium macrophyllum* has been examined (CGE) and confirms its identity as the taxon currently known as *Kennedia macrophylla* (Meisn.) F.Muell. or *Kennedia macrophylla* (Meisn.) Benth., both combinations being illegitimate. The next available name for this taxon is *Kennedia lateritia* F.Muell., of which type material at MEL matches the type of *Physolobium macrophyllum*; the former name is therefore adopted for this taxon. Full synonymy for this species is as follows.

Kennedia lateritia F.Muell. *Fragm.* 4:78 (1864). *Type*: Ex horto. bot. Melbourne (*lecto*: K, here designated; *isolecto*: MEL 252613). *Paralecto*: 'In Nova Hollandia occidentali [Western Australia] *herb. F. Mueller'* (MEL 252615).

Physolobium macrophyllum Meisn. in J.G.C. Lehmann, *Pl. Preiss.* 2: 222 (1848); *Kennedia macrophylla* (Meisn.) F.Muell., *Fragm.* 4:79 (Feb. 1864) *nom. illeg. non* Lindl. (1836); *K. macrophylla* (Meisn.) Benth., *Fl. Austral.* 2: 252 (Oct. 1864) *nom. illeg. non* Lindl. (1836). *Type*: 'Swan River, *Drummond*, coll. II, No. 118' (*holo*: NY; *iso*: CGE *n.v.* (image CANB), K (2 sheets), MEL 252722, P *n.v.* (image CANB), W).

From the available type material of *K. lateritia*, the specimen at K is chosen as the lectotype as it has both flowers and fruit present, best representing the protologue.

In 1836 Lindley described a new species, *Kennedia macrophylla* [as *Kennedya? macrophylla*], commenting that it 'is in many respects so much like *K. comptoniana* [= *Hardenbergia comptoniana*] as to render it doubtful whether it is more than a variety of that species'. Images of type material of *Kennedia macrophylla* Lindl. held at CGE have been examined and confirm that it is indeed *Hardenbergia comptoniana* (Andrews) Benth. The synonymy of this species is as follows.

Hardenbergia comptoniana (Andrews) Benth. in S.L. Endlicher *et al.*, *Enum. Pl.* 41 (1837); *Glycine comptoniana* Andrews, *Bot. Repos.* 9: t. 602 (1810); *Kennedia comptoniana* (Andrews) Link, *Enum. Hort. Berol. Alt.* 2: 235 (1822); *Caulinia comptoniana* (Andrews) F.Muell., *Fragm.* 7: 128 (1871). *Type*: 'We have named it in honour of Lady Northampton in whose collection at Castle Ashby it flowered last April. But by whom it was introduced we are uncertain' (*lecto*: the plate, *Bot. Repos.* 9: t. 602 (1810), here selected).

Kennedia macrophylla Lindl., *Edwards's Bot. Reg.* 22: t. 1862 (1836); *Hardenbergia macrophylla* (Lindl.) Benth. in S.L. Endlicher *et al. Enum. Pl.* 41 (1837); *Caulinia macrophylla* (Lindl.) F. Muell., *Fragm.* 7: 128 (1871). *Type*: 'Introduced by Sir James Stirling from the Swan River in New Holland. It was raised in the garden of Robert Mangles, Esq. at Sunning Hill from whence specimens were received' (*holo*: CGE).

Acknowledgements

Thanks are due to the Directors of AD, K, MEL, NY, PERTH and W, for loaning material in their care, also to Alex Chapman (ABLO 1999) and Jenny Tonkin (ABLO 2007) for providing images from CGE and P respectively, and to Brendan Lepschi for helpful comments on the manuscript.

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Referees for Volume 18

The assistance of referees in providing expert review of papers submitted to *Nuytsia* is gratefully acknowledged. The referees consulted for Volume 18 include those listed below. Each paper was also refereed internally by *Nuytsia* Committee members.

Jeni Alford
Albert Blarer
Alex George
Peter Grayling
Surrey Jacob
Bronwen Keighery
Niels Klazenga
Nicholas Lander
Kristina Lemson
Brendan Lepschi
Terry Macfarlane
Bob Makinson
Maurice McDonald
Daniel Murphy
Dean Nicolle
Martin O'Leary
Kevin Thiele
Neville Walsh
Paul Wilson

Corrections

Volume 16(2)

Page 414. Under heading **Taxandria conspicua**, line 4: the type specimen has the date 13 December 1840. On the photograph in PERTH it shows Octbr. 13 40. It has been databased as 13 October 1840.

Volume 17

Page 206. Figure 4. *Andersonia redolens*: replace A – holotype with A – isotype.

Page 289. Under heading **Abstract**, line 8: replace *D. microphyllum* with *D. microphylla*.

Page 313. Under heading **Dicrastylis gilesii**, subheading *Dicrastylis gilesii f. densa,* line 2: replace 01603124 with 03716171.

Page 313. Under heading **Dicrastylis gilesii**, subheading *Dicrastylis gilesii* var. *laxa,* line 2: replace 03716023 with 01603124.

Page 335. Under heading **Goodenia granitica**, line 4: replace 07464320 with 07734395.

Page 343. Under the heading **Goodenia turleyae,** line 5: replace Scadden with Scaddan.

CONSERVATION CODES FOR WESTERN AUSTRALIAN FLORA

R: Declared Rare Flora – Extant Taxa (= Threatened Flora= Endangered+ Vulnerable) Taxa which have been adequately searched for, and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Threatened Species Scientific Committee.

X: Declared Rare Flora – Presumed Extinct Taxa Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searhcing, or of which all known wild populations have been destroyed more recently, and have been gazetted as such, following approval by the Minister for Environment, after recommendation by the State's threatened Species Scientific Committee.

1: Priority One – Poorly Known Taxa Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral aniamls, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2: Priority Two – Poorly Known Taxa Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

3: Priority Three – Poorly Known Taxa Taxa which are known from several populations, at least some of which are not believed tobe under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.

4: Priority Four – Rare Taxa Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5–10 years.

Publication date for Nuytsia Volume 17: 5 December 2007

NOTES FOR AUTHORS

Nuytsia publishes original papers and short communications on systematics, taxonomy and nomenclature of Australian (particularly Western Australian) plants, algae and fungi, with preference given to papers dealing with new taxa, revisions, systematic analyses and classifications, censuses, invasive species, and nomenclatural and taxonomic issues. Book reviews will not be accepted. All papers are peer reviewed and should not be under consideration elsewhere. No page charges apply.

Authors should read and follow the comprehensive guidelines for authors available at http://science.dec.wa.gov.au/nuytsia, paying particular attention to the following:

Manuscript format. Double-sided with 1.5-line spacing throughout. All text should be in the typeface (bold, italic etc.) in which it will be published. Manuscripts may be submitted by email, in MS-Word format.

Title. Should be concise and include the family name of genera or species treated (but not authorities) and geographic scope where appropriate. New taxa should be named if not numerous. Full author's names should follow the title, followed by institutional addresses keyed by superscripted letters. An email address should be given for the Corresponding Author, if possible.

Abstract. Must comprise a single paragraph and provide a stand-alone summary of the paper for abstracting services. All new names and combinations made in the paper should be listed if possible.

Names. Nomenclatural authorities must be provided for first instances of all taxonomic names below the rank of family, both in the Abstract and in the body of the text.

Headings. Principal headings should be bold and centred; second-order headings should be italicized, left-justified and separated from the following text by a stop without paragraph break.

Keys. May be either indented (e.g. *Nuytsia* 18: 45) or bracketed (e.g. *Nuytsia* 18: 149). Indented keys involving more than nine levels of indentation should be avoided.

Conservation status. Conservation Codes as used by the Department of Environment and Conservation should be recommended for rare and threatened taxa; these will be assessed by Department staff during review of the paper. Precise localities and georeferences should not be given for Declared Rare and Priority taxa; instead, cite generalized localities only, accompanied by the statement "[Precise localities withheld for conservation reasons]".

Abbreviations. The following standards are used for abbreviations:

- Nomenclatural authors: *Authors of Plant Names* (Brummitt & Powell 1992).
- Bibliographic references (nomenclatural sections only): *Taxonomic Literature II* (Stafleu & Cowan 1976–1986; Stafleu & Mennega 1992–) for books; *Botanico-Periodicum-Huntianum (*Lawrence *et al.* 1968) for journals.
- Herbaria: *Index Herbariorum* (Holmgren *et al.* 1990).

References. Citations in the text should be of the form *Author's Surname(s) (year) [or (year: page)]* with full details given in the Reference section. Use an ampersand to separate two authors, and *First Author et al.* for three or more authors. Citations in the References section should be of the forms:

- *Journal article*: Butcher, R. (2007). New 'leafless' *Tetratheca* (Elaeocarpaceae, formerly Tremandraceae) taxa from Western Australia. *Australian Systematic Botany* 20(2): 139–160.
- *Book*: Paczkowska, G. & Chapman, A.R. (2000). *The Western Australian flora: a descriptive catalogue.* (Wildflower Society of Western Australia: Nedlands, WA.)
- *Chapter in a book*: Rye, B.L. (1992). Myrtaceae. *In*: Wheeler, J.R. (ed.) *Flora of the Kimberley Region*. pp. 499–546. (Western Australian Herbarium: Perth.)
- *Website*: Western Australian Herbarium (1998–). *FloraBase – The Western Australian flora.* Department of Environment and Conservation. http://florabase.dec.wa.gov.au/ [accessed May 2008]

Images. Images may be embedded in the body of the paper for submission and review; image resolution and quality should be sufficient but not excessive, to allow the complete manuscript to be emailed. After final acceptance of the paper, images must be supplied as separate files and removed from the body of the text. Instructions regarding formats, resolution etc will be sent with the review letter.

Reprints. Twenty reprints of each paper will be provided free of charge to the corresponding author. PDF versions of all papers will be made available via the journal's web site.

An updated diagnosis for *Eucalyptus* series *Accedentes* (Myrtaceae) and a new mallee species for the series occurring in far western Australia. D. Nicolle and M.I.H. Brooker 189

A revision of *Eucalyptus* ser. *Cornutae* subser. *Conjunctae* (Myrtaceae) from the south coast of Western Australia, including the description of four new taxa and comments on the hybrid origin of *E. bennettiae*. D. Nicolle, M. French and N. McQuoid 197

Recognition of new taxa in *Grevillea* (Proteaceae: Grevilleoideae) from south-west Western Australia. P.M. Olde and N.R. Marriott 223

Seorsus, a new Gondwanan genus of Myrtaceae with a disjunct distribution in Borneo and Australia. B.L. Rye and M.E. Trudgen 235

Tecticornia papillata (Chenopodiaceae: Salicornioideae), a new andromonoecious samphire from near the Carnarvon Range, Western Australia. K.A. Shepherd 259

New combinations in the genus *Dysphania* (Chenopodiaceae). K.A. Shepherd and P.G. Wilson 267

Pilostyles coccoidea (Apodanthaceae), a new species from Western Australia described from morphological and molecular evidence. K.R. Thiele, S.J. Wylie, L. Maccarone, P. Hollick and J.A. McComb 273

Stylidium perplexum (Stylidiaceae): a remarkable new triggerplant from south-west Western Australia. J.A. Wege 285

A new subspecies of *Gnaphalium indutum* (Asteraceae: Gnaphalieae). P.G. Wilson 291

Coronidium, a new Australian genus in the Gnaphalieae (Asteraceae). P.G. Wilson 295

Notes on the genus *Chrysocephalum* (Angianthinae: Asteraceae) with he description of one new species from Western Australia, and a new combination. P.G. Wilson 331

Short Communications

Lepidosperma amansiferrum is an orthographic error of *L. amantiferrum*. R.L. Barrett 339

Kennedia lateritia, a new name for *Kennedia macrophylla* (Fabaceae). T.R. Lally and P.G. Wilson 340

Other contents

Referees for Volume 18 342

Corrections to Nuytsia Volume 16(2), 17 342

Conservation Codes for Western Australian Flora 343

Publication date for *Nuytsia* Volume 17 343

Notes for Authors 344

CONTENTS

Main papers

An annotated census of the mosses of the Perth Region, Western Australia. L.J. Biggs and J.A. Chappill 1

Platytheca anasima (Elaeocarpaceae) a new, geographically restricted species from the Whicher Range, south-west Western Australia. R. Butcher 31

Rediscovery of *Tetratheca nuda var. spartea* (Elaeocarpaceae) in south-west Western Australia and elevation to specific rank as *Tetratheca spartea*. R. Butcher 39

Atriplex eremitis (Chenopodiaceae), a new species from northern Western Australia. R.J. Cranfield 49

Further new taxa in *Banksia* (Proteaceae: Grevilleoideae). A.S. George 53

Three new species of *Leucopogon* (Ericaceae: Styphelioideae: Styphelieae) from the far south-west of Western Australia. M. Hislop 61

A new subspecies of *Rorippa* (Brassicaceae) from southern Western Australia. G.J. Keighery 79

Elucidation of *Olearia* species related to *O. paucidentata* (Asteraceae: Astereae). N.S. Lander 83

New species of *Olearia* (Asteraceae: Astereae) from Western Australia. N.S. Lander 97

A review of *Acacia coolgardiensis* (Leguminosae: Mimosoideae) and closely related species in Western Australia. B.R. Maslin and C. Buscumb 107

Acacia diallaga (Leguminosae: Mimosoideae), a new geographically restricted species with diallagous phyllodes from the Midwest Region of south- west Western Australia. B.R. Maslin and C. Buscumb 127

Acacia umbraculiformis (Leguminosae: Mimosoideae), a new species related to *A. quadrimarginea* from the Midwest Region of south-west Western Australia. B.R. Maslin and C. Buscumb 133

New taxa of *Acacia* (Leguminosae: Mimosoideae) and notes on other species from the Pilbara and adjacent desert regions of Western Australia. B.R. Maslin and S. van Leeuwen 139

(Contents continued inside back cover)

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